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Engineering News-Record

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July 14, 1927

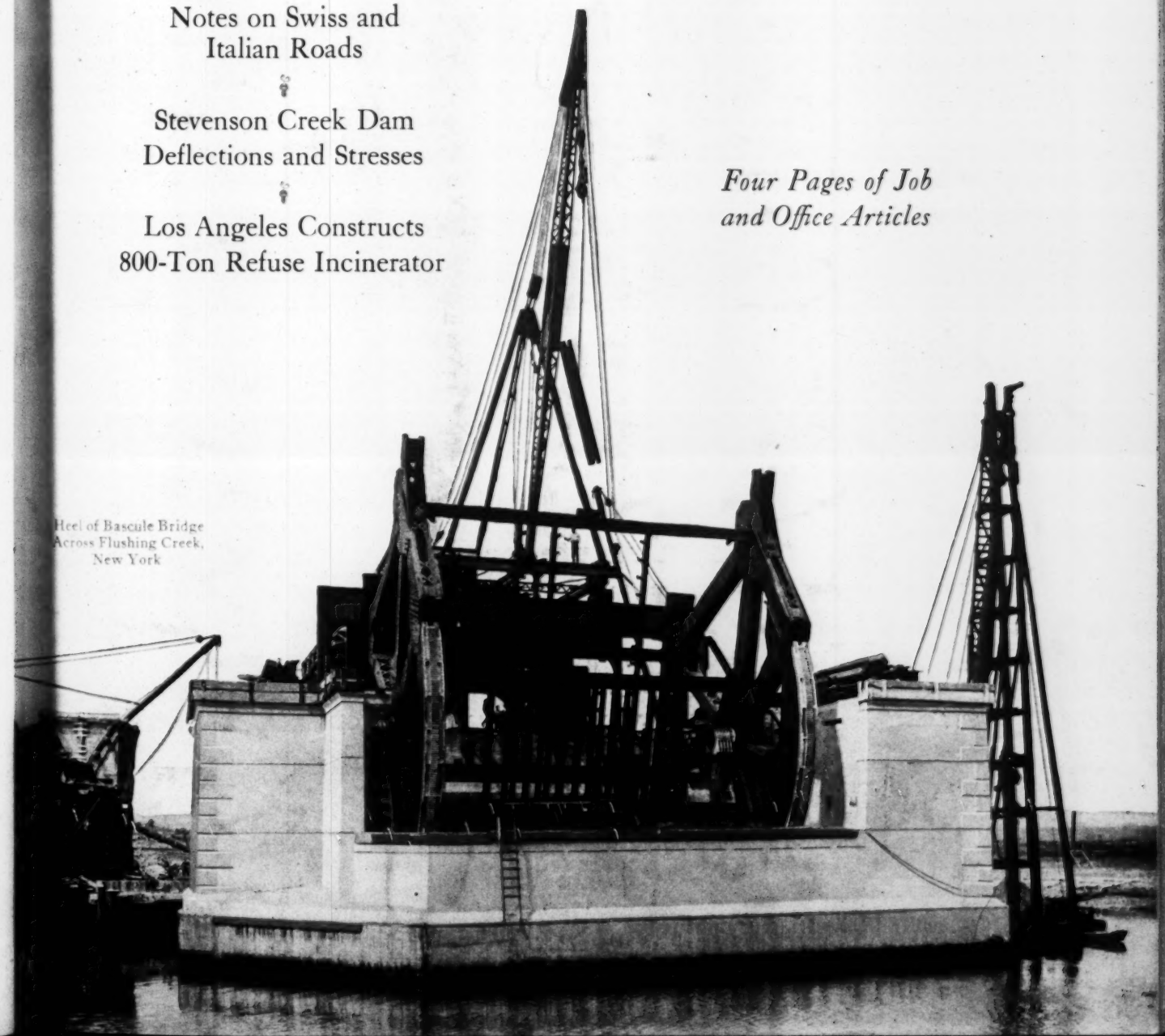
Floating Caisson Construction of Bascule Bridge Piers

Notes on Swiss and Italian Roads

Stevenson Creek Dam Deflections and Stresses

Los Angeles Constructs 800-Ton Refuse Incinerator

Four Pages of Job and Office Articles



Heel of Bascule Bridge Across Flushing Creek, New York

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DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

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Misfortune Can Serve

WITHIN the past few days a fresh illustration of the utterly unexpected possibilities of flood disaster has come into the news, in the shape of reports from Germany of a tremendous cloudburst flood in the Saxon mountain regions. Early reports indicate that the flood flow was greater than has been known for possibly centuries. The proportions of the disaster in terms of losses are not yet definitely reported, but it is likely that they will be smaller than those of many destructive floods experienced in the United States in recent times. The Saxon flood, however, has one element of differentiation from our own flood experiences, namely, the fact that there is an unbroken memory and record of river behavior in the European region for many centuries past, while our empirical outlook in this country is limited to very few years, in many regions not more than four or five decades. The European case indicates that very long time contingencies have to be reckoned with in providing protection against floods. We have been prone to think, in connection with our own flood experiences, that if we can determine the highest flow that has occurred within fifty or seventy-five years, or perhaps a hundred, we will have the measure of the most extreme possibility that need be reckoned with. Some engineers, it is true, have recognized the possibility of much longer-time variations, taking the view that the possible size of flood increases with the increase of time interval considered. But even this recognition has been weakened by the almost inevitable tendency to consider that a 200- or a 500-year contingency represents a danger that is actually 200 or 500 years in the future, and therefore not worth protecting against. That this is a thoroughly unsound habit of thought needs no argument in the abstract; but for more concrete and convincing demonstration we look to long-interval floods such as that which has just visited a Saxon valley. A clear appreciation of this represents the service that we may draw from that disaster.

Contractors' Service Plants

HOME conditioning and servicing of construction equipment at central plants is a phase of the contracting business which has recently come to the front. A notable illustration of this type of industrial plant is presented in this issue. There are few of equal size and elaboration and indeed not many of a comparable nature. Contractors, since machinery has assumed an important place in construction, have always had their job repair shops. Of necessity they have had to have storage yards for idle equipment. At these places they have done such overhauling and replacement work, generally not much exceeding high class blacksmith work, as comes within the range of simple means. The plant described in this issue, which a large building contractor has put up in Chicago, is considerably larger than any of these old style job and storage yard shops. A similar plant located in New York was illustrated in our issue of Jan. 15, 1925. Both the Chicago and New York plants combine service, repair and storage besides doing a considerable amount of manufacturing. They are truly industrial establishments for special service which have been called into being by the increasing mechanization and the growing centralization of the business of construction. As both mechanization and centralization extend, the number of these plants is bound to increase, and their growth will have to be taken account of in altered line-ups by equipment makers, commercial repair shops and used-equipment dealers.

A Fundamental Attempt

AT WISCONSIN and Cornell there is in progress the first step in an interesting experiment, one aimed at strengthening the fundamentals of engineers' training. A short course for teachers in engineering mechanics is being conducted at the two schools. Lectures and discussions have been arranged to bring out the essential difficulties of the subject—difficulties as between teacher and student—and to bring about more effective teaching of this basic subject. The course is planned to be the first step in a review of all the basic subjects of engineering instruction. It is an outgrowth of the general study of the present status of engineering education that has been in progress for two or three years and is being carried out under the auspices of the Society for the Promotion of Engineering Education. As a demonstration of the live spirit and deep sense of responsibility of those engaged in teaching engineering, the short course experiment is perhaps the most important development in engineering education within memory. What it will accomplish in the way of teaching teachers remains to be seen; we hold to the general belief of non-educators that he who knows his subject thoroughly can also tell another what he knows, that is, he can teach, and we are not willing to believe that there are teachers of mechanics who do not know their subject thoroughly. However, teaching is the field of a specialist, and the layman's belief may not work out in detail. But regardless of what the course accomplishes in producing actually better teaching knowledge, it has great potentialties in the direction of strengthening the teaching spirit, and making more clear in the minds of educators the essential obligations which they bear toward the receptive, inquiring minds that come before them yearly in the hope of entering the great profession of engineering.

Taking Chances Again

ANOTHER accident in building construction illustrates again the dangers of taking chances. In this case, as noted in our news columns, the steel-frame for a six-story building was erected to an unusual height without riveting, all connections being made by service

bolting. Apparently, also, some of the framing was omitted. When subjected to a high wind the structure collapsed. Fortunately the accident occurred in the night and the wreckage did not fall on adjacent buildings, so that nobody was hurt. With the storm coming a few hours later or from a different direction there might have been a more serious tale to tell. This accident seems to be comparable with those in concrete construction which result from neglect of cold-weather precautions or from premature removal of forms. In the absence of an official inquiry, since there were no casualties, the direct responsibility for taking chances and the consequent disastrous results probably never will be made known. But the very fact of the accident should be a fresh warning to avoid haste and neglect of precautions, and to heed the present very desirable movement for insuring safety on construction work.

The Spring Valley Purchase Defeat

FOR the fourth time the voters of San Francisco cast an actual majority of their votes in favor of municipal purchase of the water-works of the Spring Valley Water Co., as announced in our news section June 23, but not the two-thirds majority required by law. Apparently, the citizens of San Francisco are for the most part well satisfied with the service they are getting from the Spring Valley Water Co. or at least not so dissatisfied but that they are willing to await further progress in the construction of the Hetch Hetchy aqueduct by the city, which is still some years from completion. They also seem to rest content with the knowledge that the option to purchase at a price fixed by the State Railroad Commission some years ago may be exercised by the city whenever it chooses prior to Dec. 31, 1933. How much distrust of existing city government of San Francisco and uncertainty as to any change for the better through the possible provision of a board to administer the water-works and other utilities may have contributed to the fourth defeat we will not undertake to say. There has been a strong feeling of late that a utility board should be created to operate the water-works when in the possession of the city and also the municipal street railway system. The bonds for the extension of the latter were also defeated at the recent election, although having an actual majority. Bonds for a war memorial and for completing the Bernal Cut were carried by the necessary two-thirds majority. In the case of all four proposed bond issues general apathy prevailed, the total number of ballots cast being only a third of the registered voters. Whatever the voters of San Francisco may do later on as to municipal street railway extension, they are so far committed to municipal ownership of their water supply that before the purchase option expires and the Hetch Hetchy works are completed, the necessary two-thirds majority for buying out the Spring Valley Water Co. is almost sure to be realized.

Designed for Easy Maintenance

SIMPLICITY and ease of maintenance are combined in the intake structure of the Waeggital power plant in Switzerland, described elsewhere in this issue. Too often, especially in this country, intake structures are built with little thought as to how they are to be maintained. Although provision may be made for lifting out the gates and racks, it is not uncommon to find unprotected steel in the gate frames or in the rack supports where it is subject to cavitation and rapid corrosion, conditions which are bound to result in extensive shutdowns for repairs at some time in the future. The Waeggital intake stands out in sharp contrast to this condition. The gate frame is of polished granite and all the metal parts of both the gate and the rack can be withdrawn for inspection and maintenance.

Ties from Old Rails

EXPERIMENTS in making railroad ties from old rails have been in progress for some time past on the Delaware & Hudson. Scrap rails and angle bars and new tie plates are used, welding two 8-ft. lengths of rail together by means of the bars and plates. These experiments are interesting, not as a solution of the wood tie problem, but as looking towards the development of a fairly cheap tie for use in places where wooden ties are difficult to renew or are subject to very hard service. For general purposes such a tie appears to have little practical value. Aside from its uneconomical use of steel, about 400 lb. per tie as opposed to 250 lb. for ordinary steel tie, the tie made of old rails has the inherent disadvantage of such ties except the cost of manufacture.

Water Control in Road Work

GRADUALLY highway departments are giving consideration to control of the water-cement ratio in building concrete roads. Five state highway specifications now limit the amount of mixing water and three other states are using strength specifications to meet which the water must be controlled to some extent. These counts are from tabulations by the Portland Cement Association. Of the five states which limit water, two place the amount per sack of cement at 5½ gal., two at 6¼ gal. and one at 6 gal. In general the specifications state that this amount shall include the water in the sand and provide for the determination of the exact measure by the state engineers on the job. About the most precise of the state specifications are those of New Hampshire as follows: "Minimum ratio of cement to total of separate volumes of fine and coarse aggregates 1 to 6. Water per bag of cement, dry aggregate, 5½ gal. The amount of moisture that is present in the aggregate must be compensated for by omitting an amount of water equal to that which is already in the aggregate. The state laboratory will assist the contractor in determining the proper proportion of fine and coarse aggregate which may be efficiently and economically used but in no case shall the proportion of fine aggregate be less than one-half of the proportion of coarse aggregate used in the mix. All mixes shall be so proportioned as to insure a 3 in. to 4 in. slump and shall be of such consistency and workability as to avoid all honeycomb pockets and harsh mixtures." For average working conditions a 5½-gal. water content including free water in the sand will give 2,800 to 3,000 lb. concrete in 28 days. More water will reduce the strength, so that the states which have a strength specification are by an inverse process also controlling the water-cement ratio. With the demand for quicker opening to traffic of concrete roads, practice appears likely to see an increase in the use of strength tests for setting opening dates and an increased attention to water control and aggregate proportions. These are possibilities which the road contractor has to look forward to and allow for in determining his prices.

Montreal Typhoid Questions

CONTINUED decline in typhoid cases at Montreal gives rise to the hope that the epidemic is nearing its end. We use no stronger word than hope because the course of the epidemic and the number of cases still being reported daily, after a run of nearly twenty weeks, indicates that typhoid infection has continued in Montreal ever since last February. Evidence of this is given by the following summary: The official date for the beginning of the epidemic is March 4—there having been only 19 cases of typhoid reported from Jan. 1 to March 3, inclusive. In the first week of the epidemic, 127 cases were reported. The curve ran up sharply for four weeks, fell almost as rapidly for three weeks, rose a bit in the eighth week, fell a little in the ninth, then rose sharply until for the eleventh week it was higher than for the fourth, with 727 cases for the seven days. There was a rapid fall for four weeks to 92 cases, in the fifteenth week of the epidemic, with no further decline in the sixteenth week, but drops in each of the next two weeks. The record for the eighteenth week ended July 7 was 46 cases.

Compared with the preceding 17 weeks, 6½ cases of typhoid a day looks small, but for the 62 days preceding the epidemic the Montreal average was one case in three days, or between 2 and 3 cases a week. How few cases a week will warrant a declaration that the epidemic is over is an interesting subject for speculation. Even assuming that the long-continuing cause of the epidemic is eradicated, a return to the pre-epidemic figure cannot be expected for some time, at least not unless drastic control measures are taken. Contact cases, which will be discussed later, will soon come to an end when all the seeds of the epidemic are killed, but the carrier problem will remain. Presumably, Montreal had its full quota of carriers before the epidemic. Those typhoid sowers have been increased many fold. If it be assumed that the epidemic stops with 5,000 cases and 500 deaths (both figures nearly reached as our news section shows), then 4,500 cases remain from which the pre-epidemic carrier-squad will be augmented to a troop of considerable size and large possible menace, numbering 100 to 200 or more.

Contact cases to June 20, states Dr. S. Boucher, Montreal health director, in answer to a query from this journal, totaled 205, or about 4.5 per cent of the 4,650 cases reported to that date. At this percentage rate, if all the 46 cases reported for the eighteenth week of the epidemic had been due to contact a thousand first cases would have been required, which would have carried the contact infection back between five and six weeks, or some three weeks beyond the longest accepted incubation period. Contact cases, according to a report by Dr. Boucher dated April 30, "are cases breaking out in a family a fortnight after the first ones were" recognized as typhoid cases. Even as regards the eighteenth week of the Montreal outbreak, it would thus appear, either there must have been a large percentage of the new cases infected from carriers, or else the original cause of the epidemic was still partly uncontrolled.

Taking an optimistic view, which seems warranted, the Montreal typhoid outbreak appears to be nearing its end, except for a long trail of scattering cases that may run to a considerable total. More confident hopes or beliefs might be expressed if specific details of the cause of the epidemic were available. Thus far, only general assertions that the epidemic is milk-borne have been made public, with mention of a typhoid carrier and of imperfect operation of pasteurizing plants. All this was so long ago that the epidemic should have been over weeks past if its real cause had been found and eradicated.

Since the foregoing paragraphs were written we have received a report on the outbreak down to June 28 (see news section). It confirms and throws light on the milk-borne theory but does not go into the line of argument followed in the foregoing discussion, except to give warning that (on June 28) "Montreal is not yet a comparatively safe place for visitors."

Geneva Resolutions Supported

THE hearty endorsement of the trade barrier conclusions (see last week's news section) of the International Economic Conference by the International Chamber of Commerce, assembled in Stockholm, gives reason for hope that the Geneva meeting will soon bear fruit. Moreover, the vigorous support of this endorsement by all the national delegations at Stockholm constitutes a pledge that each group will go home ready to urge prompt action by its government in accordance with the Geneva-Stockholm resolutions as an essential first step in the improvement of national conditions. Certainly nothing can so speedily contribute to the revival of Europe. Such a revival is imperative. Should the movement started at Geneva fail, we would, as Sir Arthur Salter has said, have reason to despair. No other course is open.

It has been a reasonable conference of men who know, fortunately, the good progress already recorded, not the least being this Stockholm endorsement. The Belgian, Austrian, Chekoslovakian, German, Dutch and Swedish ministries have declared their approval and intention to take action. The Council of the League of Nations is working on the details and will reorganize the economic section for more effective action. In September the League Council and Assembly will again consider these problems. A diplomatic conference on some of the items has been called for October. It is therefore certain that the huge force to be set in motion through the coming action of the various national committees of the International Chamber of Commerce will be reinforced by a whole string of efforts directed toward the same end.

At first sight the task would seem impossible because of the selfish national ambitions involved, but all European business men realize that the trade barriers erected for national self protection have failed to bring prosperity. Counter barriers have been erected and the flow of goods has been checked with resulting impoverishment at home. This "collective insanity," as Sir Arthur Salter called it, is now recognized by all business men and by many statesmen. The business men must carry general conviction to the public and the governments.

There is good reason to hope for results aside from the selfish desire for better business. There is the larger impelling motive of improving conditions for the multitudes now suffering from a reduced standard of living. The need to relieve them is frequently expressed. With such motives and with such forces in motion there must be results.

Floating-Caisson Construction of Bascule Bridge Piers

Ingenious Modification of Old Process Used to Overcome Difficulties in Founding Double-Deck Crossing of Flushing Creek at Roosevelt Avenue

By Edwin I. Judd
Resident Engineer, Department of Plant and Structures, New York City

A BRIDGE built during the past year over Flushing Creek on the line of Roosevelt Avenue by the Department of Plant and Structures of New York City for a street and elevated railway crossing involved unusual foundation work. The foundation required to be built in soft ground at considerable depth, nearly 40 ft., under conditions that made it difficult to handle deep excavation. The foundation itself, it was clear, had to be piled, but the problem was to construct the body of the pier on this pile foundation. It was solved by an ingenious application of the floating-caisson method of construction. The work was carried out under the direction of Commissioner Albert Goldman and Chief Engineer Edward A. Byrne, of the Department of Plant and Structures. The method was developed by the Arthur McMullen Co., contractor for the bridge.

The bridge is a double-deck two-leaf bascule span carrying a three-track railroad on its upper deck and a roadway 42 ft. 8 in. wide and two 9-ft. sidewalks on its lower deck. Each leaf is carried by two trusses 25 ft. 6 in. deep center to center of chords, spaced 47 ft. 4 in. on centers, of length 153 ft. overall. Though the channel is only 70 ft. wide, the skew of 42 deg. required a clear span between piers of 162 ft., making the span between the trunnion centers 212 ft. The distance between pier foundations is 144 ft. Each leaf is supported on two forged-steel trunnion pins 28 in. in diameter by 8 ft. 2½ in. long passing through the lower chord and turning in bearings supported by steel columns that rest on grillages concreted in the foundation slab of the pier.

The foundations of the piers are rectangular, 93x118 ft., with bottom 36 ft. 9 in. below mean high water. The main body of the pier is 78x100 ft., but the corner facing the channel is cut away for clearance. The height of the main body walls above foundation is about 57 ft. The interior of the pier is an open well which accommodates the counterweight and the tail of the span when open; this pit is about 42x56 ft. at the bottom, the floor being about 13 ft. above bottom of foundation. The total dead weight on the footing, including the span, is about 23,000 tons. This load is supported by wooden piles 3 ft. on centers.

At present the river affords a 40-ft. channel with about 19-ft. depth of water, bordered by mud flats covered at high tide. Preliminary investigation indicated that piles would have to be driven to about 60 ft. below mean high water to develop sufficient bearing power. The surface material at the banks is clay and soft mud, which slope about 3 to 1.

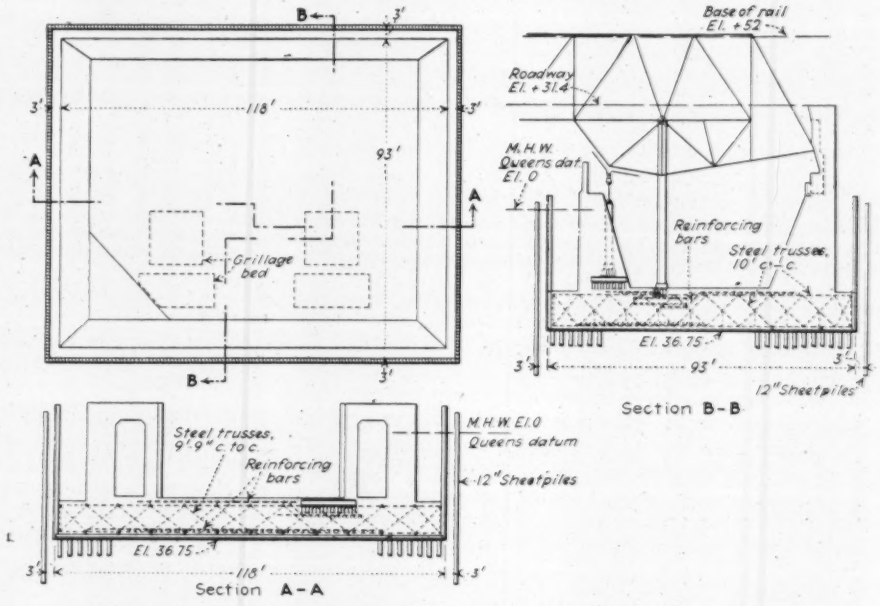


FIG. 1—STRUCTURE OF BASCULE PIER FOR ROOSEVELT AVE. BRIDGE
Built by floating-caisson method at depth of 40 ft.

Pier Site Conditions—The choice of method to be used in building the piers was of first importance. On account of their large size, and depth (about 40 ft. below m.h.w.), a heavy cofferdam would be necessary in order to prevent disturbance of the ground over a large area, as the soil was a heavy clay which slumped badly when thoroughly wet. Open cofferdam construction, however, presented many difficulties which made this method impracticable, if not impossible. The bottom of foundation was to be at —36.75, and there was to be a heavy mat of reinforcing steel about 2 ft. above the bottom. Steel grillages were to be set about 9 ft. above the bottom, and the floor of the open pit was to be about 13 ft. above bottom. It would be necessary that the

cofferdam be kept dry to insure the best quality of concrete and to permit setting the reinforcement and grillages. This, however, in view of the size of the cofferdam, would call for exceptionally heavy construction even in favorable material, while in the soil actually encountered blows through the floor might be expected unless the sheeting were driven to prohibitive depth and the adjacent river bottom heavily blanketed. Moreover, the working area was limited by the traffic on the river. The floor of the pier being relatively thin for the foundation pressure, it was questionable whether the concrete could be placed to hold against the great pressures on the floor of the cofferdam and yet be made strong and dense enough to insure a dry pit.

Floating Caissons Adopted—The method adopted was a combination of the open cofferdam and floating caisson methods. A heavy cofferdam was driven around the pier site to prevent disturbance of the ground during excavation, but was not braced, as it was not to be unwatered; the interior was excavated and piles were guide piles. The sheeting, of Oregon fir 12x12 in. by 55 ft., with a slice point, was made up in units of three pieces drift-bolted together and having 2-in. splines tacked to the ends of each section. The corner pieces were set first and then the sides, working from the corners towards the center. A 3,000-lb. drop hammer of special design, with rectangular striking face about 15x36 in., which allowed driving these large units evenly, did the work. At first the driving was done with a floating driver working inside the box, but later it was found more satisfactory to use a rig which rolled on tracks on the working platform. The driving was very hard, and in most cases a jet was needed for the last 10 ft. The sheeting was driven to 49-ft. depth, leaving the top about 6 ft. above water. At one side of the cofferdam the sheeting was driven to low water for a length of 30 ft. to form a gate where at high tide floating equipment could be moved in and out of the cofferdam. The size of the cofferdam allowed about 4-ft. clearance on all sides of the floating caisson.

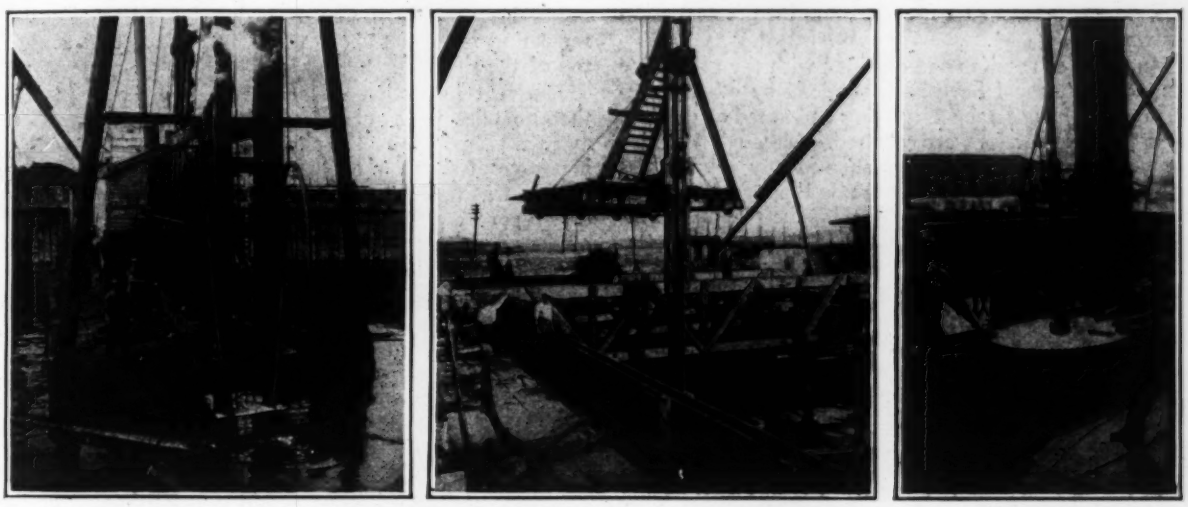


FIG. 2—PILEDRIVING AND SAWING, FLUSHING CREEK BASCULE PIERS

driven and cut off under water; and finally a floating timber caisson was built inside the cofferdam, within which the pier was constructed, sinking the caisson progressively until it was seated on the foundation piles. This method insured absolutely dry conditions for the placing of the concrete and for the setting of reinforcing and grillages, and allowed the foundation concrete a set of several weeks before it was subjected to the action of salt water or high pressures.

Construction of the piers by this method was a complete success, due largely to the care with which all details of the work were planned and carried out.

Preliminary Work—All fixed plant had to be carried on piles and about 15,000 yd. had to be dredged before the plant could be built. Floating derricks using clamshell buckets and loading into scows did this dredging, and similar floating rigs drove piles for a working platform 30 ft. wide extending around the cofferdam site as well as for stiff-leg derricks set at the corners of the cofferdam to reach all parts of the work.

While the plant was being erected, work began on the cofferdam. Two inside 12x12-in. wales were set, at low water and about 4 ft. above high water, bolted to

Excavation inside was carried on by a clamshell bucket handled by the derricks at the corners, loading into scows of about 800-yd. capacity. Before driving, the site had been dredged to about —17, and the final excavation was carried to —39, through heavy blue clay except for coarse sand near the bottom. The digging became hard enough to require teeth to be put on the buckets, but even so the digging was very slow in the last 10 ft., so that the time for loading a scow with 800 yd. increased from 10 hr. to 30 hr. The total amount of material excavated in each cofferdam was about 12,000 yd. When excavation had progressed to within 5 ft. of the bottom, soundings were taken daily in order to keep the floor approximately level.

Piledriving—The foundation piles in the cofferdams were driven with a floating driver using a double-acting submarine hammer which worked in auxiliary leads moving in the fixed leads. In driving, hammer and leads were first raised so that the foot of the leads was at water level, the pile was swung into the leads and its weight held by two pointed dogs fastened in the foot of the leads, the hammer was lowered to near the top of the pile, and the leads, hammer and pile were lowered

until the bottom of the leads rested on the bottom. Then the weight of the hammer was allowed to come on the pile, forcing its point into the ground and releasing the dogs, which dropped into slots in the leads. The hammer had a net weight of about 13,000 lb., with 3,600-lb. ram and 20-in. stroke. With a boiler pressure of about 100 to 120 lb. and air pressure about 25 lb. in the chamber between ram and striking plate, a speed of about 115 blows a minute was obtained, developing 20,000 ft.-lb. per blow. The air pressure kept the chamber free of water while the hammer was submerged and prevented cushioning of the blow.

Each pier foundation contained about 1,300 piles, spaced a fraction less than 3 ft. on centers. Spruce piles were used, in lengths from 20 to 35 ft. with butt measurement of 12 in. and point of 6 in. The driving was very hard, and piles were driven to practical refusal; the penetration under the last ten blows indicated a bearing power of about 30 tons. The penetration varied from 20 ft. average in the west pier to 25 ft. in the east pier. With seven men on the driver, about 85 piles were driven in an 8-hr. shift, and the greatest number was 107.

Much better results were obtained with the submarine hammer than could have been obtained by other methods, due to the accuracy of spacing and speed of driving, as no followers or jet were required. Although the driving was hard, only few piles showed any injury, and in these cases the damage to the pile top was due to the hammer working a little off line with the pile and striking on one side.

Pile Sawing—It was important that the piles be cut to accurate elevation and level plane, as otherwise excessive strains might be set up in the floor of the pier pit when the caisson was seated, and the floor might crack. For this reason a floating saw rig was considered impractical and a rig was used which traveled on track carried on fixed supports. The traveler carriage consisted of two timber deck trusses of 42-ft. span and 10-ft. depth, about 16 ft. apart, with light cross-bracing between trusses. A small tandem wheel truck at each end of each truss ran on a rail extending parallel to the long sides of the cofferdam. The top chord of each truss carried a 30-lb. rail on which the machinery platform moved, a timber platform about 15 ft. square carrying a steam engine at one end, belt-connected to the saw shaft which was supported vertically at the other end. The trucks of this platform were geared to a hand operating wheel on the platform by which it was moved backward and forward along the carriage. The saw shaft was a 3-in. steel shaft 60 ft. long hung in bearings fastened to a 16x16-in. timber spud; this spud in turn was bolted to timber guides which were fastened rigidly to the platform and extended 12 ft. below and 16 ft. above. For changing saws, the spud and saw shaft could be removed by unbolting them from the platform guides. The saw was a heavy 42-in. circular saw attached to the shaft with countersunk tap bolts.

Sawing was done in three lanes parallel to the long sides of the cofferdam. The first lanes cut were the outside ones, and one rail of the traveler was supported on the cofferdam sheeting and the other on temporary piles inside the cofferdam. The middle lane was cut after the outside ones, and the traveler was supported on temporary piles driven for both rail supports.

To begin cutting, the saw was set in line with a row of piles by the aid of a diver, and the platform was moved along the carriage by the hand wheel; when this row was completed the carriage was moved ahead about half the distance to the next row of piles by pinch bars, and the saw platform was run back on this line. Movements of the machine had to be made carefully to avoid jamming and breaking the saw, and therefore it was found advisable to move ahead only half the distance between pile rows and thus to sweep the entire area of the foundation. Some difficulty was experienced when a leaning pile was encountered, and it was necessary often to manoeuver around the pile and cut it on two sides before the top would float up. The saw blade was changed at least once every 8 hr., as the saws dulled quickly, due to the action of sand sucked up by the swirl of the saw.

The rig allowed very accurate setting and control of elevation. The rails were set level, and by means of a mark on the saw shaft a known distance above the blade, the saw blade was set to elevation with an engineer's level. Adjustment for elevation was made by regulating lock nuts above the swivel connection at the top of the shaft.

Frequent inspection was made by a diver to insure that no piles were missed as cutting proceeded. The average progress was 100 piles cut in 8 hr., with a working force of six men, engineer and foreman. When the sawing was finished, all holes found in the floor of the cofferdam were filled with gravel to within a few inches of the pile tops, and the pile tops were swept clean.

Floating Caisson—The floating caisson consisted of two major parts, the lower 12-ft. section being a permanent part of the pier, and the upper 29-ft. section removable.

The lower section consisted of a floor of dressed 4-in. timber which came to the site in 12 sections 15 ft. 9 in. by 59 ft. 6 in. or 20 ft. 6 in. by 38 ft. 6 in. On the upper side of the floor were timber stringers about 5 ft. on centers, running parallel to the long sides of the caisson. The interior stringers in each section were 8x12-in. timbers, dressed, fastened with boat spikes to the floor, while around the edge of each section was an 8x16-in. timber which extended to the bottom edge of the floor and was dapped on its lower inside edge to receive the floor plank. The floor sections were floated into the cofferdam and were assembled by bolting through the edge stringers of the sections. Each floor section had been calked and pitched before it was floated in; after the floor was assembled the joints between sections were calked with yarn and cotton and painted with pitch. The sides of this lower section were made of 4-in. plank fastened with boat spikes to 8x12-in. posts spaced 5 ft. on centers around the sides, the posts and sides being built up after the floor had been assembled. A force of calkers followed behind the dock builders and calked and pitched each plank joint as the sides went up. This 12-ft. permanent section measured 93x118 ft. inside of planking, which was the neat dimensions of the pier foundations.

The upper section, seated on the lower section and of the same size, consisted of 12x12-in. posts 28 ft. long spaced 5 ft. on centers, and 6-in. planking fastened with boat spikes to the posts. The planking was built up to panels 6x15 before being brought to the site, to save time in assembling. The corner pieces came to the

site made up for the full height of the section with legs of about 9 ft. on each side, and cross-braced inside. This removable section of the caisson was held to the lower permanent section by 1¼-in. rods which ran through an 8x12-in. cap on top of the upper section and threaded into sleeves which were bolted to the posts of the lower section. These rods, which were about 30 ft. long, were spaced 10 ft. on centers.

A distinctive feature of the caisson design was the incorporation of steel stiffening trusses in the floor of the caisson, 11 main trusses in the short direction and 9 secondary trusses in the long direction. The main trusses were 91 ft. long, about 9 ft. 6 in. deep, with top chord of two 6x6-in. angles, bottom chord of two 10-in. channels and web members of single 4x4-in. angle crossed-diagonals with subverticals to the bottom chord of two 3x3-in. angles. The secondary trusses, 116 ft. long, were 8 ft. 4 in. deep, with chords of two 6x6-in. angles and crossed diagonals of 3½x3½-in. angles. The main trusses came to the site assembled, and were fastened to the timber floor stringers by screw spikes 30 in. apart; then the secondary trusses were assembled in place and the end posts of both sets of trusses were fastened to the 8x12-in. posts of the lower section of the caisson with screw spikes. Brackets of two 6x4-in. angles at the ends of the trusses were fastened to two 12x16-in. wales of the removable section of caisson; these not only supplemented the holding-down rods and anchored the removable section, but also stiffened the caisson so that no interior cross-bracing was necessary for the lower part of the removable section. The bases of the brackets were about at the foundation offset, and when the top section of caisson was to be removed the brackets were burned loose and removed with it.

The stiffening trusses prevented any distortion of the caisson while it was being sunk, and made it possible to use a light timber floor where otherwise a very heavy floor would have been required. They also stiffened and reinforced the permanent concrete floor of the pier.

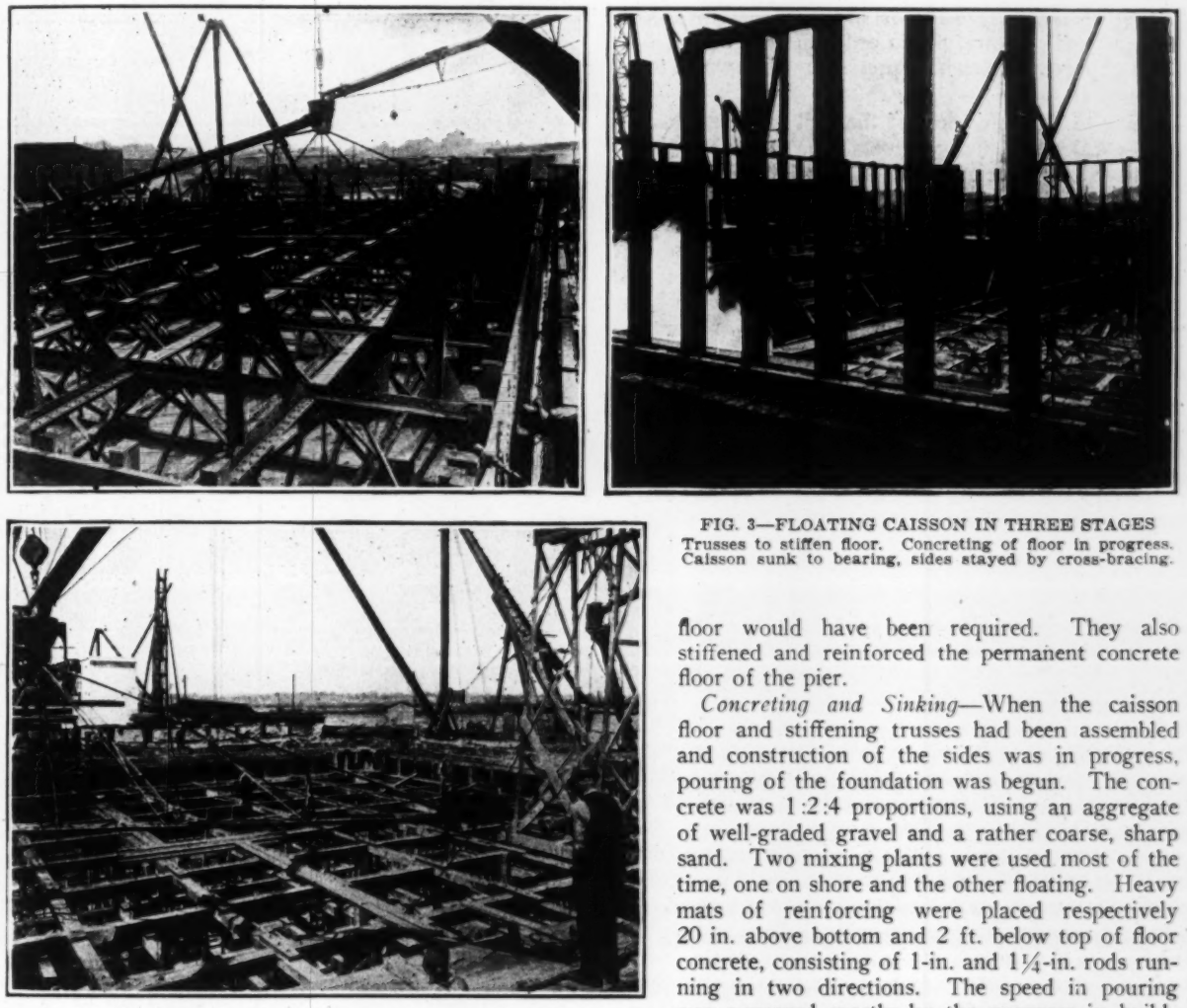


FIG. 3—FLOATING CAISSON IN THREE STAGES
Trusses to stiffen floor. Concreting of floor in progress. Caisson sunk to bearing, sides stayed by cross-bracing.

Concreting and Sinking—When the caisson floor and stiffening trusses had been assembled and construction of the sides was in progress, pouring of the foundation was begun. The concrete was 1:2:4 proportions, using an aggregate of well-graded gravel and a rather coarse, sharp sand. Two mixing plants were used most of the time, one on shore and the other floating. Heavy mats of reinforcing were placed respectively 20 in. above bottom and 2 ft. below top of floor concrete, consisting of 1-in. and 1¼-in. rods running in two directions. The speed in pouring was governed mostly by the progress in building the upper section of the caisson, for as the caisson settled the side panels were set and calked, and the calking, done from floating platforms, could not be kept far enough ahead to allow pouring every day. Interior 12x12 cross-bracing was set in the upper section of the caisson at heights of 11 ft., 16½ ft., and 24½ ft. above the top of the lower section, all 10 ft. on centers, supported by 8x8-in. posts, and bearing against 12x16 and 12x12 wales fastened to the side posts of the caisson.

Pouring was done as evenly as possible over the foundation area, so as to keep the caisson approximately level at all times. When the base slab had been poured, the caisson had settled about 26 ft. in the water, leaving its base about 12 ft. above the pile tops at high water

and about 5 ft. above at low water. The concrete, 4,300 yd., was about 40 per cent of the total concrete in the pier, and the displacement of the caisson was about 9,500 tons. When seated on the piles at mean high water the caisson would displace about 13,200 tons, so that nearly 4,000 tons of additional load had to be placed before the caisson would be seated permanently. This introduced a new problem: It was relatively easy to keep the caisson in balance while the foundation was being poured, as this was practically a slab of uniform thickness (except for the grillage pockets), but above the slab the concrete was of irregular arrangement. The pouring of the body walls of the pier, therefore, had to be planned out carefully in order to keep the caisson level and prevent unbalanced pressures which would tend to distort it.

Owing to the differences of the wall sections, the unsymmetrical pier plan above foundation due to the channel corner being cut off, and the fact that full wall sections could not be poured until the grillages and columns for supporting the bridge were in place, balance had to be maintained by placing temporary loading in the caisson as pouring proceeded. For this purpose the granite which was to form the pier facing between high and low water was used; it was in blocks of about 3 tons, and a total of about 1,000 tons was used for this extra loading. At the channel corner particularly heavy loading was necessary. The position of the caisson was checked frequently by readings on elevation gages set on the outside face of the caisson, showing water level elevation above floor.

The large three-tier beam grillages in the front wall of the pier, just above top of foundation, were set and concreted in when the pouring reached this elevation and before the caisson was finally seated. This allowed construction of the front wall for better balance of the box, and enabled the outside wall of the pier to be concreted complete without breaks. In order to allow for slight deviation from true line or elevation which might develop in seating the caisson, these grillages were set an inch low, to allow for shim plates on the grillages, and the holding-down bolts in the grillages were set in pipe sleeves to allow a small movement of the bolts if needed to bring to true line.

All instrument work for line and elevation was done inside the caisson while it was floating. The number of elevation gages on the inside of the box showed true elevation as measured from the caisson floor. Lines and levels were run inside the caisson by adjusting the transit or level instrument to the plane of the floor, which would be a level plane when the caisson was seated. The instrument work done in this way all checked very closely, and after the caisson was seated most of the grillages set while the caisson was floating showed less than $\frac{1}{16}$-in. variation from true elevation, and no variation from line.

Particular care was taken to prevent leakage through the construction joints of the pier walls. At each horizontal pouring joint a large wooden trough form was set at the top of the pouring, and when pouring was continued this form was removed and the trough was painted with a waterproofing composition. At the vertical joints, sheets of heavy copper about 12 in. wide were placed as flashing in the joints. These precautions proved very effective, as there has developed practically no leakage into the pier pit.

When the pouring of the walls had progressed to the elevation of the first line of caisson bracing, the caisson was still afloat. The pressure on the side walls of the caisson was transferred at this elevation to the concrete pier walls, and the bracing removed. The normal rise and fall of the tide was about 7½ ft., so that at low tide the caisson rested on the foundation piles part of every day for nearly two weeks before it was finally seated in permanent position.

At the time of this final seating, cable lines were attached to all corners of the caisson, and when the caisson was drawing within 6 in. of final draft at mean high

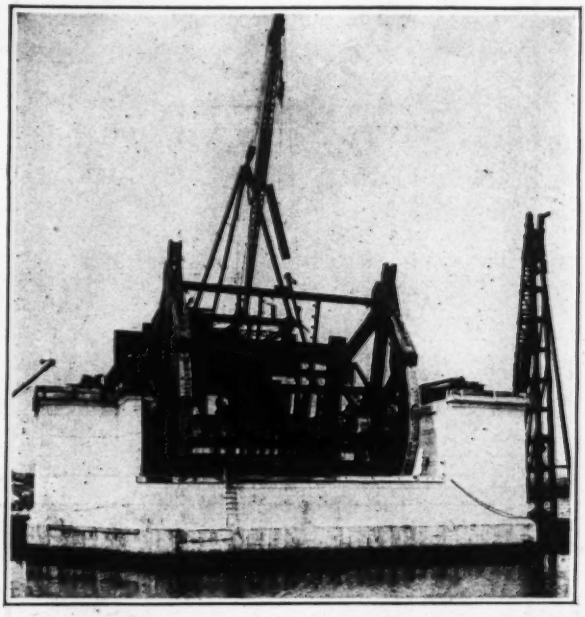


FIG. 4—HEEL OF BRIDGE IN PLACE ON COMPLETED PIER

water and was in level position, it was brought and held to line by these cables, was seated on a falling tide, and then weight was added as rapidly as possible. Concrete was poured continuously, and in addition water was admitted to the space between the pier and the inside of the caisson for a height of about 20 ft. to insure holding it against an extra high tide until wall construction progressed far enough to hold it securely against displacement. At the time the caisson was seated, about 12,000 tons of concrete were in place, or something over 1,000 tons less than the total displacement at high water. This remaining portion of weight was made up of the timber in the caisson, about 150 tons of grillage and reinforcing steel, and temporary weight supplied by granite blocks. The outside walls of the pier at this time were about 11 ft. below mean high water.

After the caisson was seated, construction of the remainder of the pier height presented no particular problems. When the first pier was completed the upper section of the caisson was removed, the sides were dismantled and the caisson was reassembled for use in the construction of the other pier. That the solution of the problems presented in the construction of these piers due to their size, special features of design and unfavorable foundation conditions was so successful, was due in large measure to the wise choice of methods and the care with which these methods were executed.

The total cost of the bridge was about $2,640,000, of

which the foundations represent about half. Work began in February, 1925, and was completed during the summer of 1926. The long construction period was in large part due to the fact that navigation requirements made it necessary to build and complete one pier before beginning work on the other.

The work was executed by the Arthur McMullen Co., contractor for the bridge. The entire structure was designed by the Department of Plant and Structures of New York City, which department designs all the fixed and movable bridges over navigable streams for the city. The Roosevelt Ave. bridge was designed under the direction of Edward A. Byrne, chief engineer. Robert E. Hawley was engineer of design, Isadore Delson, bridge engineer, Martin Joachinson, mechanical engineer, George H. Hefele, division engineer, and the writer resident engineer.

D. & H. Railroad Experimenting with Ties Made from Old Rails

EXPERIMENTS looking toward the use of scrap rails for making railroad ties have been carried on by the Delaware & Hudson Co. during the past year with such success that the company has decided to undertake the fabrication of a large number for installation in sidings and yard tracks.

Each tie is made of two 8-ft. lengths of old rail welded together as shown in Fig. 1. Pieces of old angle iron

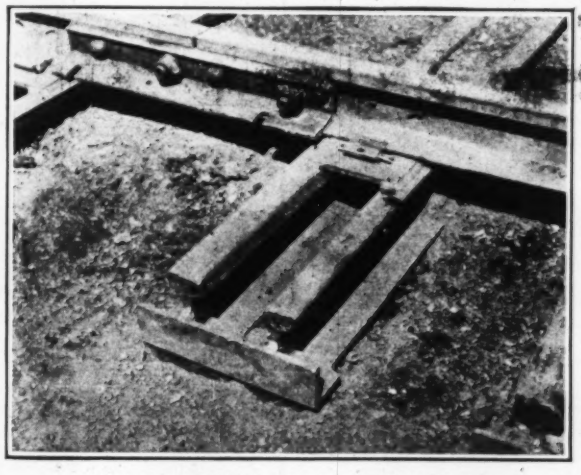


FIG. 1—TIES MADE FROM SCRAP RAILS

or old angle bars are used to hold the ends together and a standard tie plate is welded to the rail head to form the rail seat.

Two types of fastening have been designed, one for use when the tie plate is punched for only one weight of rail and the other for a variable width of rail base. Spring keys hold the clips in position. A section of these fastenings is shown in Fig. 2. The rail clip shown in Fig. 1 was an experimental type which has been superseded by the one shown in Fig. 2.

In figuring the costs of these ties, it is neccessary to include the cost of scrap rails and scrap angle bars only to the extent of the interest on their scrap value as their value as scrap material will be little affected by their use for this purpose. In comparing the cost of these ties with wood ties, however, it is unnecessary to include the cost of the tie plate as a tie plate is required for wooden ties. The value of the spikes saved about offsets the cost of the special rail clips. It is estimated that the cost of labor and material used in welding the ties, exclusive of the value of the scrap material, will be between

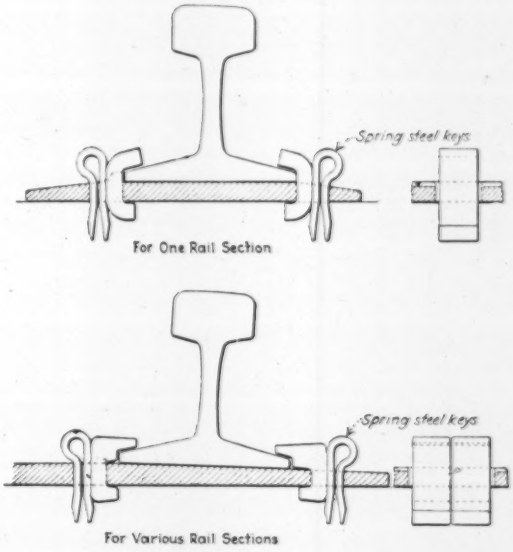


FIG. 2—CLIPS USED TO SECURE RAILS TO METAL TIES

60 and 80c. per tie, possibly as low as 60c. where many ties are fabricated. Assuming the scrap value of the old rails to be about $2.50, this gives a cost of about $3.10 as against $2.80 for a wooden tie. However, much of the scrap value of the old rail may be recovered, whereas a wooden tie has no scrap value at the end of its severe life.

This work has been carried on under the direction of H. S. Clarke, engineer, maintenance-of-way, the Delaware & Hudson Co., and William Dalton of the General Electric Co., who has supervised the electric arc welding.

Typhoid Outbreak at Watseka, Ill.

A city water supply which was repeatedly classed as unsafe by the state health department was considered, though not definitely proved, as the cause of a typhoid fever epidemic at Watseka, Ill., in October and November, 1926, according to a report made by the state quarantine officer. In a population of 5,000 with 750 water users there were 34 cases and 3 deaths. One theory was that a surcharged sewer caused pollution of the ground near the public wells. Since June, 1919, periodical examinations have shown the city water from two drilled wells, pumped by direct suction, to be of doubtful sanitary quality and in some cases unsafe. These conditions were reported to the mayor and council from time to time, with frequent recommendations for continuous chlorination, while the water has been condemned and prohibited for use on trains on account of its failure to meet the requirements of the U. S. Public Health Service. A chlorinator was installed in November, 1926, but was not made use of until after the epidemic was well under way.

Los Angeles Constructs 800-Ton Refuse Incinerator

Will Burn Refuse from Business Districts—Seven Incinerator Bids Compared on Basis of Operating Cost

COMBUSTIBLE refuse in Los Angeles that is not included in the collections made by city scavengers, as well as large quantities of waste from industrial and wholesale districts of that city, has for some years been collected by licensed private scavengers and delivered to dumping and burning grounds designated by the city authorities. The principal place of disposal is on the bank of the Los Angeles River where the surrounding territory is such that there is a minimum of nuisance complaint.

To avoid the danger that public nuisance might later result from this open burning, and in the endeavor to secure complete and odorless combustion, the city in 1924 undertook to work out a satisfactory solution of the problem. Bids were called for and last year a contract was signed for the construction of a refuse incinerator near the west bank of the Los Angeles River on East 26th St., a location near the center of the industrial district, so that only a short haul will be required on the major portion of this class of refuse. The plan is to charge for disposal at this incinerator on a tonnage basis to be worked out later.

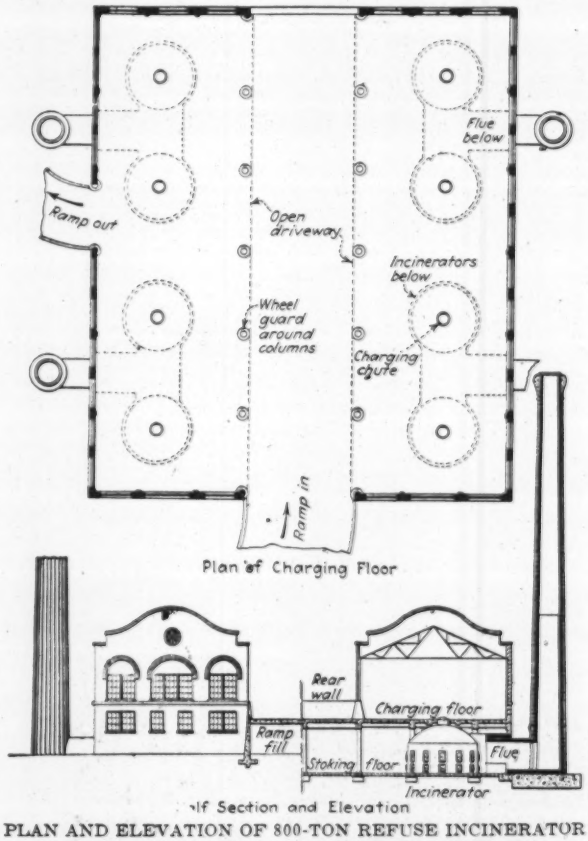
In Los Angeles, non-combustible household refuse and kitchen waste are required to be kept in separate cans, and are collected by the city. The food waste goes to the Fontana hog farm, described in *Engineering News-Record*, Aug. 6, 1925, p. 208, and the non-combustible refuse is delivered to a salvage plant, described in the issue of March 31, 1927, p. 526. The new incinerator will dispose of a third class of refuse not included with either of the two just mentioned.

In the contract for the new refuse incinerator, the material to be burned is specified as 65 per cent wet garbage or its equivalent and 35 per cent dry rubbish. The latter includes packing boxes, excelsior, papers, packing, and in general a large percentage of waste having a high fuel value. The "wet garbage" percentage is made up in considerable part of market refuse from the large wholesale terminals. The city will also use this means of disposal for some of the combustible street sweepings.

When the incinerator bids were opened in the summer of 1926 the proposals of 7 firms were found to qualify and in order to make a comparative study of these tenders they were classified and analyzed as shown by the accompanying table. In this table the cost of the plant per ton was found by dividing the bidder's price by the 24-hr. capacity in tons. The labor was figured at prevailing local rates for all three shifts per 24 hr. and the comparative figure was reached by dividing the total labor cost by the number of tons per 24 hr. The repairs and maintenance per ton were taken as 1 per cent per year of the price bid. The standby labor charge was figured as 1.5 per cent of labor cost per ton on a 200-ton plant and 1.2 per cent of labor cost per ton for the 400-ton plant. The total operating cost is figured on a 20-year basis, listed both on a tonnage basis and as a total figure, including 40 years' interest and amortization on the bid price.

As the table shows, this analysis credited the Nye proposal with a great advantage in costs of maintenance and operation and accordingly a $370,000 contract was awarded in October, 1926, to the Nye Odorless Crematory Co., of Macon, Ga., under terms that require the plant to be ready for service in September, 1927. The incinerator has beehive-shaped furnaces with top-feed holes 4¼ ft. in diameter. Trucks drive directly onto the charging floor, which is 9 ft. above ground level, back up to the charging hole and dump directly into the furnaces.

These furnaces are notably low in grate area; the total floor area of each unit is 200 sq.ft. which consists of 132 sq.ft. of hearth and 68 sq.ft. of grate area. This feature is regarded as an important factor in the expected low operating cost. The furnaces are arranged



PLAN AND ELEVATION OF 800-TON REFUSE INCINERATOR FOR THE CITY OF LOS ANGELES, CALIF.

Mixed refuse from wholesale and industrial districts burned at expense of producers. City has two-collection system for other sections: garbage shipped to privately-owned hog ranch; refuse goes to salvaging plant.

in pairs with a single stack 100 ft. high serving each pair.

The circular shape of the furnaces is expected to facilitate raking from the side openings of which nine are provided. No extra fuel is to be used. Preheated air is delivered under the grates by means of heavy vitrified pipes which pass along the combustion chamber. The furnaces are lined with a highly refractory brick adapted to quick changes in temperature that will occur in these furnaces due to the frequent charges of fresh refuse. The furnaces have a special insulating material between the fire brick and the outside red brick covering, and are steel jacketed up to the springing of the domes.

Ashes and clinker from pits below the furnaces are

COMPARISON OF BIDS ON INCINERATOR TO HAVE CAPACITY OF 800 TONS IN 24 HOURS

Items	Superior	Hiler	Nye	Bannister No. 3	Bartlett-Snow	Decarie	Bannister No. 4 Automatic Feed
Total cost of plant	$335,000	$318,000	$370,000	$380,000	$747,000	$1,310,000	$415,000
Differences between bidders	$17,000	$52,000	$10,000	$367,000	$563,000		
Cost of plant per ton	$418.75	$397.50	$462.50	$475.00	$933.75	$1,637.50	$518.75
Cost relation to low bidder	1.05	1.00	1.16	1.20	2.35	4.12	1.30
Cost per ton incinerated:							
Labor (no weighmen)	$0.6310	$0.7630	$0.3310	$0.7625	$0.9160	$1.3330	$0.3790
Power, light and water	.0218	.0329	.0101	.0069	.0521*	.0413*	.0372
Repairs	.0134	.0127	.0148	.0152	.0299	.0525	.0166
Interest average over 20 years	.0619	.0588	.0684	.0702	.1380	.2421	.0767
Amortization over 20 years	.0671	.0637	.0741	.0761	.1496	.2624	.0831
Stand-by labor	.0076	.0092	.0040	.0092	.0111	.0161	.0061
Total operating cost	$0.8028	$0.9403	$0.5024	$0.9401	$1.2967	$1.9474	$0.5987
Relative to low operating cost	1.59	1.87	1.00	1.87	2.58	3.88	1.19
	$686,400	$2,185,997	$2,184,998	$1,780,147	$3,248,295		
Total cost for 20 years	$4,007,578	$4,693,978	$2,507,981	$4,692,979	$6,473,126	$9,721,421	$2,988,710
Relative to low bidder	0.854	1.00	0.534	1.30	1.376	2.065	0.635

*These two items include use of four cranes.

The table is based on the following allowances for labor, power, light, etc.:

Labor—All figured similar for 3 shifts per 24 hr. One superintendent at $20 per 8 hr. and two at 90c. per hr. for 8 hr. each. Cranemen, if required, at 90c. per hr. and 1 extra man. All other labor 60c. per hr. for 8 hr. No scale or office men.

Power—Kw.-hr. as stated by bidder multiplied by city power rates.

Light—All figured on cubic contents of building.

$$\frac{\text{Hiler floor plan} \times \text{unit cost of light}}{\text{Hiler cubical content of building}} = \text{the constant used to obtain other amounts}$$

Water—33,000 cu.ft. per month.

Repairs and Maintenance—1 per cent per year on bid price.

Interest on Bonds—Figured as if paid up in 20 yr. or life of plant

$$= \frac{\text{Price} \times .9225}{20 \text{ yr.} \times 312 \text{ d.} \times \text{tons}}$$

Amortization of Bonds—Figured as if paid up in 20 yr. or life of plant

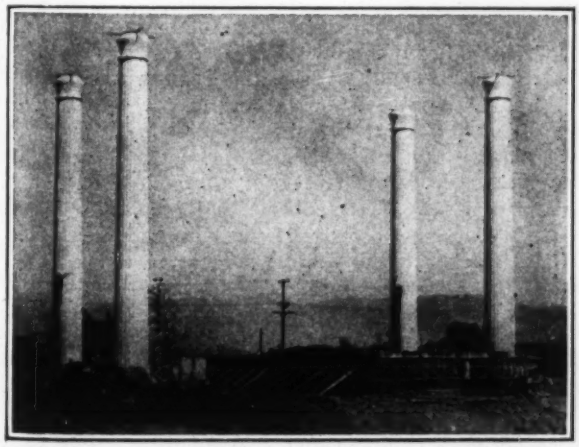
$$= \frac{\text{Bid price}}{20 \text{ yr.} \times 312 \text{ d.} \times \text{tons}}$$

Stand-by Labor—1.2 per cent of labor cost per ton based on 3 men per 8-hr. shift Sundays and holidays. This is figured on Hiler plant. Other plants in proportion to labor cost per ton.

The figures in the next to the last line of the table are the totals of (1) price bid; (2) operation cost for 20 years; (3) capital charges (interest and amortization) for 40-yr. bonds arbitrarily doubled to offset shorter life of plant, which is shown as 20 yr. This doubling of the 40-year payments was a last-moment action, to offset an argument that the plant would not last 40 years. As a matter of fact, the figures given cover an amortization period of 14 years.

to be disposed of by an overhead monorail tramway system extending to an embankment adjoining the plant, below which is a hole several acres in extent which was formerly used as a sand and gravel pit and was excavated to a depth of about 60 ft. Since the sides of this excavation are standing on a slope of 1:1 close to the plant, there will be capacity for ash and clinker disposal for many years.

The arrangement of the furnace in pairs effects not only a saving in chimney cost but reduces danger of smoke or odor nuisance when starting up, by giving the second furnace the advantage of the hot combustion chamber of the unit already operating. This chamber has a "checker" brick cross wall at the base of the stack and other construction features expected to secure a high degree of combustion.



CHIMNEYS FOR EIGHT-UNIT REFUSE INCINERATOR, LOS ANGELES

Reinforced concrete, 100 ft. high, brick lined to inside diameter of 74 in. at base and 66 in. at elevation 4 in. below top, where lining stops. Lining 9 in. thick for first 40 ft., then 4 in. to top, with 2-in. air space. Lining held concentric with concrete by 12 brick in each 10 courses made 2 in. larger than the others. Weep holes through astragal prevent water from running down and staining outside of chimney. Similar holes at bottom give air circulation between lining and concrete to reduce temperature of latter.

The incinerator building is 110 x 123 ft. in plan. The charging floor is reached by a ramp on a 4 per cent grade, 23 ft. wide, and there is a side exit leading down on a 10 per cent grade. Charging floor loads were figured for a distributed live-load of 250 lb. per sq.ft. and concentrated wheel loads of 9,000 lb. per wheel at all points on the floor that may be reached by truck wheels.

By adopting a circuitous route for trucks coming into the plant from the adjoining street there is provided standing room for 130 trucks on city property. Thus in case of any delay or congestion at the plant, waiting trucks will not be lined up on the street. Truck scales with a 9 x 20-ft. platform and a capacity of 20 tons are provided at a convenient point and all vehicles are weighed in and weighed out. The charge per ton for disposal is to be adjusted to meet the over-all operating cost of the incinerator.

The contract provides that an official test of the incinerator is to begin after a 5-day "tuning up" period. The test is to be for 3 days beginning with furnaces cold. Specifications require that the furnaces must be operated without creating a nuisance by emission of offensive odors, noxious gases, dust or smoke, and contain the specific statements that "at no time except in starting fires in cold furnaces or in burning unusual kinds of rubbish shall any smoke escape from the chimney of a degree of darkness or density greater than that determined by chart No. 1 of Ringelman's smoke scale" and "practically no dust shall be emitted from the stack."

John C. Shaw is city engineer of Los Angeles and R. W. Stewart is chief deputy city engineer. The construction of the incinerator is under the supervision of W. H. Pinkham, engineer for the city. Ralph W. Lawton is the Pacific Coast representative of the Nye Odorless Crematory Co.

ROAD OVER THE SIMPLON PASS

Notes on Swiss and Italian Roads

By E. J. Mehren

Vice-President, McGraw-Hill Publishing Co., Inc.

TO GO through the mountain or over it is a question for the traveler no less than for the engineer, though the traveler's question is relatively insignificant in weight. Having the choice, we decided to go over the mountain. So on May 25 an American newspaper journalist and I climbed the Simplon Pass by auto. On the previous day we had driven from Geneva to Martigny, Switzerland, and on May 26, ran down from Stresa to Milan, and later to Turin. There was thus an opportunity to see something of roads in Switzerland and northern Italy. A few observations will be set down, but with the warning that this is not a technical article. Time did not allow a visit to the highway authorities nor even to make, en route, a thorough technical examination.

Road Condition—Motoring in Switzerland is a joy. The main roads are dustless, well-kept, wide enough for fast two-lane traffic, of bituminous construction. There is every road reason, then, for full enjoyment of the more intimate contact one gets by road than by train with the picturesque villages and their people and with the scenery, both peaceful and grand.

In Italy it is different and I should judge that motoring there will not prove popular with Americans. Even on main roads they still bathe in the dust that to us is but a memory and there is much rough road besides. Occasionally there is the welcome relief of a stretch of tar or asphalt. The Italians do not let the dust or the roughness interfere with their pleasure. They ride, in great majority, with tops down, swathed in cloth helmets and begoggled like airplane pilots. Incidentally, the Swiss, too, ride with tops down; one sees better, particularly in a mountainous country. It should be observed, here, that the open car is generally used in these two countries.

Climbing the Simplon—Climbing the Simplon by motor is not as exciting as it may sound. The grade is fairly stiff, requiring low speed on a Ford for considerable distances, but the width is ample for two-lane traffic, the curves rarely sharp. In fact, the standards are very high. Napoleon's engineers laid out the road and built it, and superficial observation indicates that the job was well done. Certainly cost was not spared to get reasonable gradients and easy curves. The climb on the Swiss side is the steeper. One rises 4,423 ft. in 13½ miles. Near the summit are a number of galleries, some entirely on rock, others of heavy timber construction. The road is said to be open for sledges in winter, though how they make their way near the summit is hard to conceive. Going through late in May, one week after the road had been opened for automobiles, the snow banks looked steep and unbroken. We got through at the summit on a one-lane road dug through these snow banks.

So much for Switzerland.

Italian Items—In Italy a feature of road construction is the placing of granite block guards, from 2 to 3 ft. high and about 10 m. apart, on both sides of the road. These separate the vehicle pavement from the foot paths. We were informed, though, that with the advent of the automobile it has been concluded that these guards are a danger and that they will be removed. They are not high nor stout enough to stop a car, nor to protect pedestrians. The only result, therefore, is that the car is damaged. The proposed solution is apparently a low continuous curb, some of which we saw on improved roads. This separation between the vehicular space and the footpath is important in Italy because of the great numbers of pedestrians going from village to village and from village homes to farms. Incidentally, bicycles in great number use the footpaths.

POPLAR LINED ROAD IN VALLEY OF RHONE, SWITZERLAND

Protection occupies an important place in the Italian mind. At railroad crossings, the gates are thrown across the road some minutes before the train is *scheduled* to appear. If it is late, the highway travelers wait. We waited 12 minutes at one crossing until the train rolled by, and my companion decided that he had waited as long as thirty. What happens if a train is wrecked and does not appear, I was unable to learn. To be sure that the law is not defied, the gates—heavy latticed steel affairs about 5 ft. high and extending clear across the road and continuous with the stout fences—are locked and the key pocketed by the gate keeper.

That Italy's road system is not up to possible standards is realized here and a large project for improving the primary road system is now in course of study. Many parties of engineers and surveyors are covering the highway network in different parts of the country. The action of the authorities so far has been favorable, but ultimate decision is reserved until the needs of the whole primary system have been studied and a cost estimate and a financial plan prepared in detail. Signor Puricelli, who came to deserved road fame by planning and building the famous "Autostrade," is the proponent of

ITALIAN ROAD ON HILLSIDE

the plan, which is backed by the highways committee of the Italian Automobile Club. Involved would be, for the eventual scheme, 20,000 km., at a cost now roughly estimated at 3½ billion lire. However, the receipts from automobile, motorcycle and drivers' licenses and the customs duties on imported automobiles and taxes on motor fuel are of such volume and have shown such growth that if half these sums were to be allotted to the amortization of road bonds, the project could be financed on a sound basis. Surveys, plans and estimates for the overhaul of the primary roads of Northern Italy are now completed, involving one-third of the total network, so that the study side of the project is well in hand.

The "Autostrade"—Mention has been made of the "Autostrade." There is no need to describe this road in detail. Be it said, though, that it is a good job and very impressive. For the sake of review, here are a few facts and figures: 84.6 km. long, reaching from Milan to the three Italian Mountain lakes—Maggiore, Lugano and Como; 14 m. wide for 32.7 km. of this length and 11 m. wide for the remainder; straight stretches of 10 and 11 and one of 18 km.; maximum grade, 3 per cent; no grade crossings with either railroads or other highways; concrete pavement with asphalt carpet; toll for a heavy car for the maximum one-way trip, 25 lire, with liberal reductions for round-trip journeys, lighter cars, and quarterly, semi-annual and annual tickets.

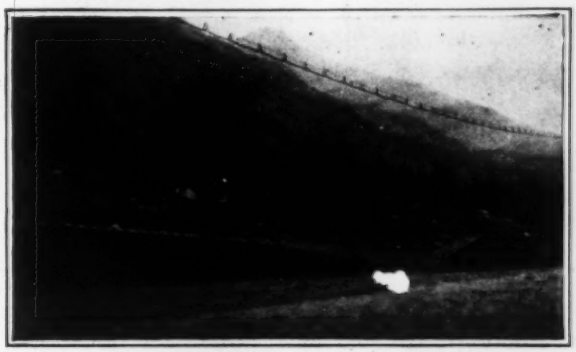
To assist the venture, the government guaranteed the interest on the bonds, but the popularity of the road has been such that the government's aid will not be needed. The receipts in 1926 were 5½ million lire, interest was paid on the bonds, and when the gross annual earnings reach 7 million lire, 5 per cent can be paid on the stock after meeting all operating and capital charges.

Unfortunately, though the "Autostrade" is a toll road and a count should be simple, no traffic records are available. The only record kept is of tickets sold, and since these are of many kinds, up to a year's available use, the figures of tickets sold are meaningless as a traffic record.

Taking a Car Through the Customs—In traveling by auto in Europe a necessary formality is to check cars into and out of the various countries. Otherwise there would be no way of telling, except by the word of the user, whether the car was to stay in a given country and thus be subject to duty. This checking is accomplished by the purchase by the motorist at a nominal figure of a registered book of coupons, and the purchase at the same time of a bond, at a reasonable insurance cost. The insurance company guarantees to pay the duty on the car should it remain in the country.

In going into a country, an entering coupon, bearing the coupon book number, the number and description of the car, its license number and country of registration, the owner's name and address, etc., is torn from the book by the customs official and sent to a central clearing office. On leaving the country, at the same or another point, the corresponding exit coupon with similar information is removed from the book and sent to the same clearing office. There is thus evidence that the car has left the country. Should an exit coupon for a given car fail to reach the clearing office in a fixed time, it is an indication that the car has remained in the country beyond the time permitted, and is subject to duty. The insurance company is called upon to make good, and, in turn, comes down on the owner. An alarm is, of course, sent out for the car so that it can be picked up and held by the insurance company until the charges are paid. The plan has been in use for many years and has proved satisfactory. It is in force in all the countries of Western Europe, except Spain.

Italy Again—Coming back to the Italian road situation again, it would seem that Italy would be well advised to improve its road system—particularly in the way of smoothness and dustlessness. (The large project already outlined involves grade reduction and curve improvement as well.) Italy is a great tourist country and better roads will attract more tourists and lengthen their stay. Tourist traffic is particularly important for Italy because her economic position demands the increase of her exports, and tourist trade constitutes an "invisible export" of goods and helps to balance her foreign trade. Further, the tourist buys in the way most favorable to the country he visits; for he buys personal service and foodstuffs, clothing, luxuries, etc., at retail. In addition, there would be great internal benefit. So there is good reason for a large Italian road program in the near future.—MILAN, MAY 30, 1927.



BRIDGE SWAMPED BY DEBRIS

A severe flood in a tributary to the Rhone filled the steambed with boulders and small stone to a depth of 3 ft. above the top chord. Then the steam changed its course. Road dug through the debris; the bridge has scarcely moved from its abutments.

Fuel Cost at Long Beach Sewage Plant

The cost of natural gas used as fuel for burning screenings at the sewage disposal plant in Long Beach, Calif., during 1925, was 20c. per 1,000 cu.ft. of gas. In the table on p. 911 of *Engineering News-Record* of June 2, 1927, which gives costs of operation at this plant, several other elements were erroneously included in the 20c. item which actually covers only the cost of gas per 1,000 cu.ft.

One of a Series of Articles on
OIL FIELD ENGINEERING

Preparing Oil Storage Tank Grades Under Rushed Conditions

Unusual Weather, Roads and Traffic Add to the Problems of Completing Nine Tank Grades in 30 Days Involving 30,000 Cu.Yd. of Material and Finishing to .05 Ft. Accuracy

TANK FARM construction, always an important civil engineering and construction problem, has assumed major significance in the Seminole County, Okla., oil field where a daily production of over 325,000 bbl. (as of March 15, 1927) must be handled by pipe lines having an aggregate capacity of only 275,000 bbl. per 24 hr. Tankage cannot be erected too fast. The Carter Oil Co., the largest producer in the field, is building tanks as fast as possible and its most recent farm, under construction 1½ miles south of the town of Seminole, is an excellent example of such work carried out under extreme conditions.

In the first place, the roads are almost impassable

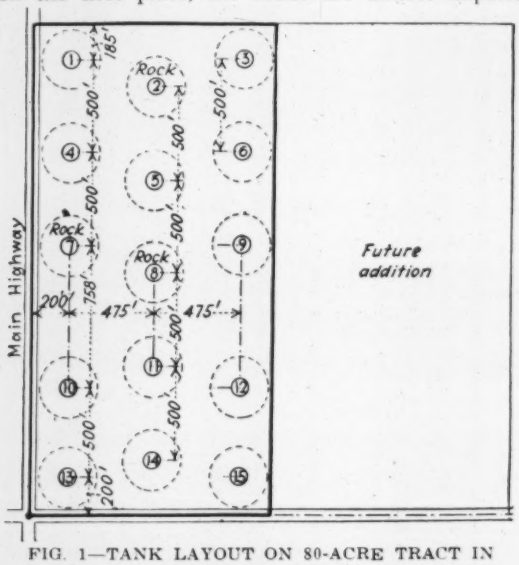


FIG. 1—TANK LAYOUT ON 80-ACRE TRACT IN SEMINOLE FIELD

both on account of mud and of traffic congestion, the latter seldom equaled in a large city. Steel for the 55,000-bbl. tanks comes into Seminole by rail, having been cut down at a farm in the northern part of the state. At the beginning the company used 60 teams to haul the steel to the site on 8-wheel wagons. Although only 1½ miles from the railroad, the haul to the farm is about 3 miles on account of detours. Four, five and six teams have been necessary for a 2,000-lb. load. The team hauling has now been augmented by the use of 10-ton crawler tractors and trailer wagons equipped with crawler treads.

Preparing tank seats for large oil storage tanks is one of the most meticulous grading operations with which a contractor has to deal. Specifications require a finish to within 0.05 ft. of the required grade over the entire seat. On this job the balling of the wet clay made this a very hard requirement. Added to these difficulties was the fact that nine tank seats had to be completed ready for steel in 30 days. As an incentive the contractors were paid 50c. per cubic

FIG. 2—TANK SEAT GRADING MADE DIFFICULT BY WET CLAY

yard for dirt excavation instead of the usual 30 or 35c. The oil company's engineers made every effort to help the contractors with their grading work by being on the job constantly to give grades when needed.

Working under such pressure it might seem that haphazard planning and construction would result. Such was not the case. The 80 acres upon which the farm is situated had been purchased several months before for a tank farm site, since its location was such that it would not interfere with operations in the productive area. Fig. 1 shows the layout adopted for this 80-acre tract. The company's standard layout provides for either 25 or 27 tanks on 160 acres, the tanks spaced 500 ft. center to center and 165 to 320 ft. from the property line. This standard layout was changed somewhat in order to get 15 tanks on 80 acres. Tanks 1, 2 and 3 in Fig. 1 had been started before the emergency order came to build the nine additional tanks. Tanks 13, 14 and 15 will be built later. (This article was written in the Seminole Field March 15. As it is published all 15 tanks are completed.) A 55,000-bbl. storage tank has a diameter of 114½ ft. Slight changes from the layout shown in Fig. 1 were also made in order to miss as much rock as possible and thus contribute to the speed of construction. The farm is known as tank farm 47 on the Witty Cudjo lease.

Engineering Methods—At the time the farm was originally laid out, contours were taken to show the direction of drainage for each tank. Water adds to the difficulty of extinguishing oil fire and drainage

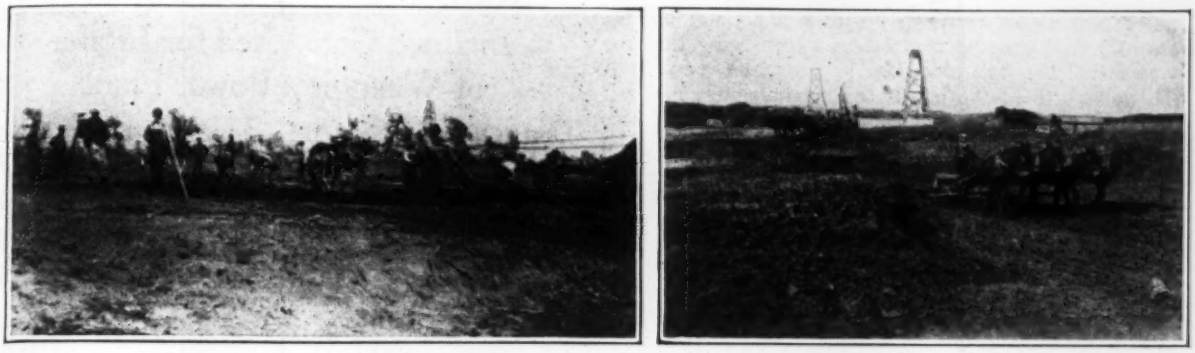


FIG. 3—RUSH GRADING OPERATIONS WITH PLOW AND FRESNOS

is therefore very important. Tank locations were next determined and, as stated, were varied somewhat from the original layout in order to miss rock, the presence of which had not been known because of the rush under which the preliminary exploration work was carried out. The farm is 1½ miles from the nearest pipe line pumping station, with probably not enough gradient for gravity flow, but the location requires a minimum amount of cut for tank seats, which under the conditions of rushed construction was the most important consideration.

Setting grade stakes for the tank seats followed standard methods, but will be described here as indicating the engineering control of this accurate grading work. Center stakes for each of the nine tanks were set as shown in Fig. 1. The center stake is the key point for all circumferential measurements. With the transit set up over the center stake, 18 arc stations of 20 deg. each were turned off clockwise on the vernier, placing Sta. 0 on an azimuth bearing zero deg. North. Some companies use the low point on the center line of the firewall as Sta. 0, but it is believed that placing Sta. 0 due north is more methodical since all grades in a farm are thus stationed alike.

As the 20-deg. stations were turned off, stakes were set 143 ft. from the center (the distance of the center line of the firewall for a 55,000-bbl. tank) and also at 70 ft. from the center. Rod readings were taken on the ground at each station to the nearest tenth and on the center stake to the nearest one hundredth.

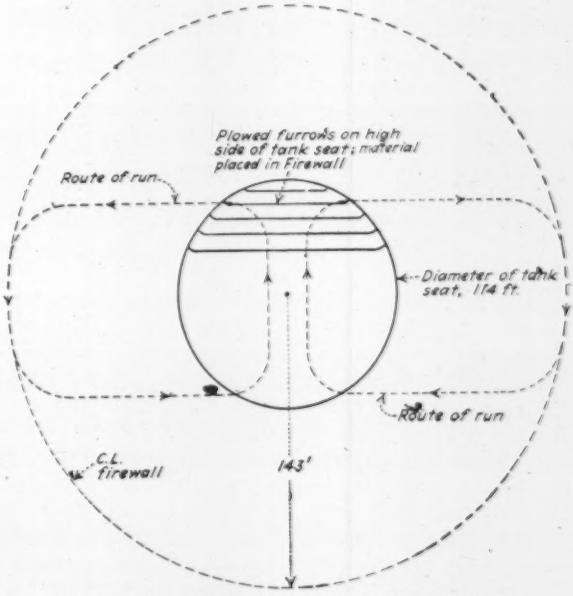

Plowed furrows on high side of tank seat; material placed in Firewall
Route of run
Diameter of tank seat, 114 ft.
Route of run
C.L. Firewall
143'

FIG. 5—DIAGRAM OF GRADING PROCEDURE
Fresnos moved material from tank seat to firewalls

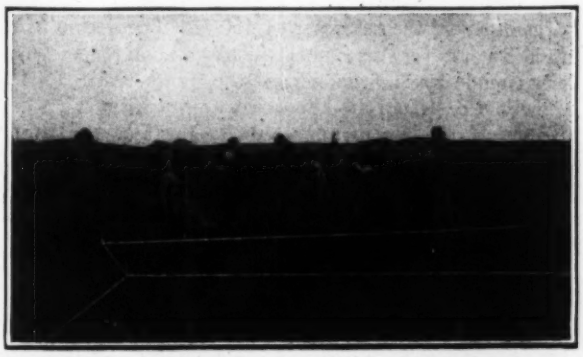


FIG. 4—FINAL GRADING TO AN ACCURACY OF 0.05 FT.

The station on the circle 70 ft. from the center, which had the lowest elevation, was the ruling station for grading work. The elevation of the final grade thus being fixed, a hole was dug at the center of the tank seat. In this the center stake was reset to an elevation 0.2 ft. higher than the final grade at the circumference, specifications requiring such a slope from the center to the edge of the tank grade. The transit bubble was used for all leveling work. Bench-marks when available are helpful, but artificial bench-marks near the grading operations are difficult to maintain. The contractor made his cut to within about 4 in. of the final grade after which the engineer set the finishing stakes or "blue tops." These were set on the radial station lines 29 and 58 ft. from the center.

Following the setting of the station stakes 143 ft. from the center on the center line of the firewall slope stakes for the firewalls were next located. Fire

walls have a 4-ft. crown, a 1½ to 1 slope, and average about 5 ft. high, the controlling factor being that the area inside the wall must be 1½ times the capacity of the tank. About 0.1 per ft. of height excess material was added to the calculated fill for shrinkage. Fill was marked on the slope stakes. Such, in brief, was the engineering procedure used on this tank farm. Grades were constantly checked as the grading work progressed.

Grading Operations—The work was divided between two contractors for the sake of speed. Unlike many other large-scale grading operations, the work is divided into a number of separate jobs. Each tank seat requires its own special organization. The work was carried on simultaneously on all of the nine tank locations. The course grading work for each tank seat required on an average eight fresnos, each pulled by three or four mules, a plow and about 15 men. Twenty to thirty men with mattocks and picks performed the final hand operations.

A unit price per cubic yard was paid for material in place in the firewall. All this material was obtained either from the tank seat or from within the firewall and placed with free haul. As stated, 50c. per cubic yard was paid for earth in the firewall. Some sandstone and loose rock was found, for which $1 a cubic yard was paid. Solid rock was removed and placed in the firewall at $2 to $2.25 per cubic yard. Thus the volume of material in the firewall determines the final contract price.

In originally breaking ground a ring was plowed around the tank site at the extreme radius, this being about 10 ft. from the edge of the tank in order to provide a drainage ditch. This ditch was later graded to drain to the low point in the circumference of the seat where a ditch led the water to the firewall, through which it was carried in a 4-in. or 6-in. pipe. After thus defining the location of the seat, the plow worked back and forth on the high side of the site. The plowed ground was removed by two "runs" of fresnos each consisting of four fresnos or in some cases slips working from the center outward and dumping the firewall.

This procedure was followed until about 4 in. above final grade. At this point, the engineer set the "blue tops" to finished grade. Fresno grading was then carried slightly deeper and the hand finishing operations were begun. Two-inch blocks were placed on top of the blue tops and strings were stretched over these. It has been the experience of the company that more rapid and accurate work can be done in this way than if the strings are placed exactly to grade. Preliminary to the hand grading operations a small trench was cut to grade beneath the string. Twenty sectors of a circle were thus defined and the hand operations consisted in removing the dirt between the small trenches down to the finished grade. Picks and mattocks, shown in Fig. 4, were used. No fill was allowed, the whole seat being in cut. Special accuracy was required at the outside ring of blue tops where the bottom angle of the tank would rest, since any inaccuracy at this point puts extra stress on the tank rivets. As fast as a tank seat was completed the steel contractor commenced the erection of the tank.

All engineering work was in charge of the Carter Oil Co., C. D. Watson, chief engineer, and F. W. Robson, engineer in charge of field operations. The grading contractors were: W. T. Robinson, Norman, Okla., and John Seybold, Tulsa, Okla.

Inclined Gate Used for Intake of Waeggital Power Plant

Deep Opening of Intake Tunnel Closed by Gate Moved on Inclined Railways—Polished Granite Used for Gate Seat

By E. A. Engler
Mechanical Engineer, Swiss North Eastern Power Co., Baden, Switzerland

The description of the Waeggital hydro-electric power development in Switzerland, given in "Engineering News-Record," Sept 9, 1926, p. 410, did not include details of an unusual intake which was built as part of the project. At the request of Mr. Gisiger, author of the article published in the Sept. 9 issue, Mr. Engler has prepared the following description of that structure.—Editor.

DEVELOPMENT of power on Waeggital Creek, a mountain stream near Zurich, Switzerland, has been accomplished by the construction of two reservoirs and two hydro-electric plants. From the upper and larger of the reservoirs, water is drawn off by a pressure tunnel whose opening into the lake was located 180 ft. below

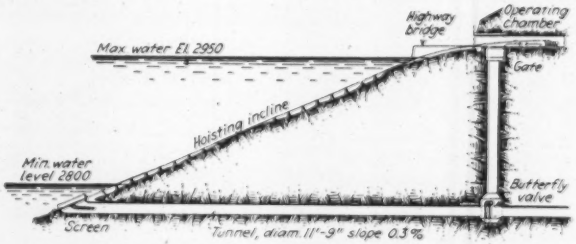


FIG. 1—SECTION THROUGH THE INTAKE, WAEGGITAL RESERVOIR

the normal water level in order to permit a maximum drawdown of the reserovir of 150 ft. The design of the intake works for this tunnel was based upon recommendations made by J. Schenker, of the Swiss North Eastern Power Co., from his experience in earlier high-head plants of the company, especially the Loentsch development. The following considerations governed: (1) Two closing devices in series are desirable, one as near to the upper end of the tunnel as possible which will be a tight fit so that the entire tunnel may be unwatered, and the second a quick-operating gate which need not be

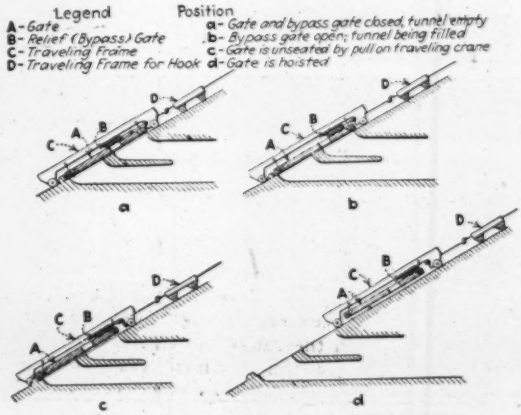


FIG. 2—DIAGRAM OF GATE OPERATION

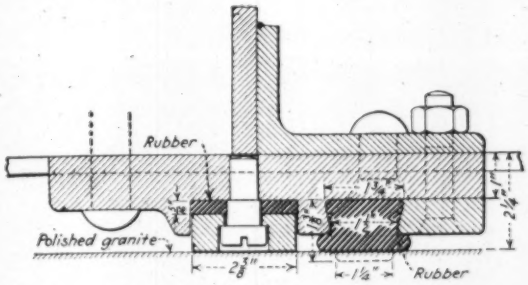


FIG. 3—DETAIL OF GATE SEAT

absolutely tight. (2) The settling of trash upon the screen may be expected to be so light that cleaning will be necessary only once a year. (3) No protective paint or coating is available which prevents corrosion of steel under water, even galvanized parts being destroyed after some time; consequently the amount of steel in inaccessible places should be reduced to a minimum. (4) Drawdown of the reservoir in winter and the consequent caving in of its ice cover may be expected to be destructive of all structures near the shore line unless very ruggedly built.

In the Waeggital reservoir, the uniform slope of the rock at the location of the intake favored the choice of an inclined hoisting track and a roller gate over the outer opening of the tunnel. The details of the intake are shown in the accompanying drawings. The circular tunnel of 11 ft. 9 in. diameter opens into the lake with a rectangular bell mouth 13 ft. wide by 33 ft. high, stiffened with a partition of streamline section. From this opening an inclined track for raising and lowering the gate extends to a chamber, blasted out of solid rock 13 ft. above the highest water level, in which the hoisting apparatus is housed. From this chamber a vertical well 14 ft. 9 in. in diameter extends down to another chamber in the tunnel which contains a butterfly valve.

The gate for the tunnel mouth is suspended from its carriage so that during travel the seating face of the gate is kept about 1½ in. above the seat. As the gate reaches its final position, it butts against a stop while the carriage is allowed to travel a few inches farther. This additional travel causes the gate to be seated on the intake frame, the face of which consists of polished granite slabs. The method of operation is shown in Fig. 2. At maximum reservoir level the gate is subjected to a pressure of 2,920 tons. When closed, it is

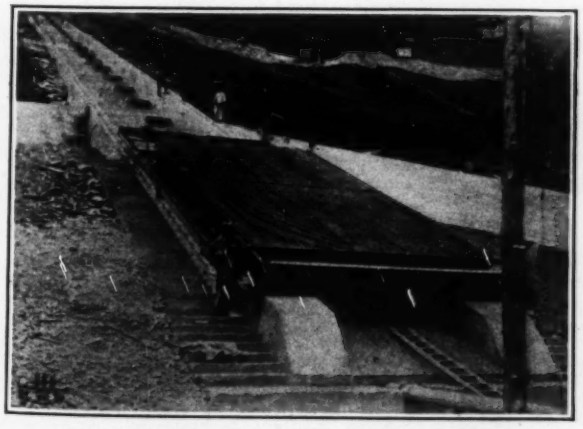


FIG. 4—TRASH RACK SEATED OVER OPENING

elastically supported by a steel bar resting on a rubber insert, while tightness is obtained with a rubber bar of trapezoidal cross-section which is inserted in a dovetailed groove in the seating faces, shown in Fig. 3. Before opening the main gate, a small relief gate in the body of the gate is opened and the tunnel allowed to fill. As soon as the pressure has been equalized, the gate can be withdrawn to the operating chamber where it may be inspected and painted. After the gate has been with-

FIG. 5—GATE BEING LOWERED TO POSITION

drawn, the screen is lowered to the opening over the same tracks. The hoisting trolley also travels this track. It has an automatic catch and release. No steel or iron parts are permanently submerged except the track, which is made of fire-galvanized rail.

In the operating chamber the gate and screen are moved off the main track with a transfer truck and an auxiliary hoist. The weight of the gate, including traveling frame, is 50 tons, of the screen 15 tons. The hoist develops a pull of 23 tons at a hoisting velocity of 19.6 ft. per minute.

The butterfly valve in the tunnel below the operating chamber has a diameter of 10.5 ft. and is connected to the tunnel by reducers of riveted steel. Its casing and the disk are of cast iron and the 13-in. shaft of forged steel. A bypass valve is provided. Both the main valve and the bypass are operated by oil pressure from the operating chamber. The well above the valve is open to the tunnel during operation.

The butterfly valve was fully assembled in the operating chamber at the time of its erection and was lowered 196 ft. to its final location with the gate hoist.

As a result of the first two years' operation, the intake has been found entirely satisfactory. The outer gate is tight and the butterfly valve has little leakage.

Contractor's Equipment Storage and Repair Plant

Crane Movement of Machines and Materials—Lumber Manipulation—Form Making—Job and Plant Repairs of Equipment

MODERN practice in the storage, maintenance and repair of contractors' equipment is seen in the repair shops and storage yard built recently at Chicago by the R. C. Wieboldt Co., a firm specializing in the construction of large buildings. Expansion at the old congested site was impracticable, but for the new yard the layout was designed to meet requirements conveniently and efficiently. In selecting a site, a spot map was made of available locations within four miles from the center of population (Madison St. and Ashland Ave.). The factors considered were initial cost, switch track facilities, proximity to main office, transportation facilities, distance from main thoroughfare, advertising value and the possibility of increase in value of the property. The ground selected has an area of 131,000 sq.ft. and is served by two switch tracks. It is about two miles from the main office, has streets on three sides and is accessible by street car and elevated railway. A general view is given in Fig. 1 and a plan in Fig. 2.

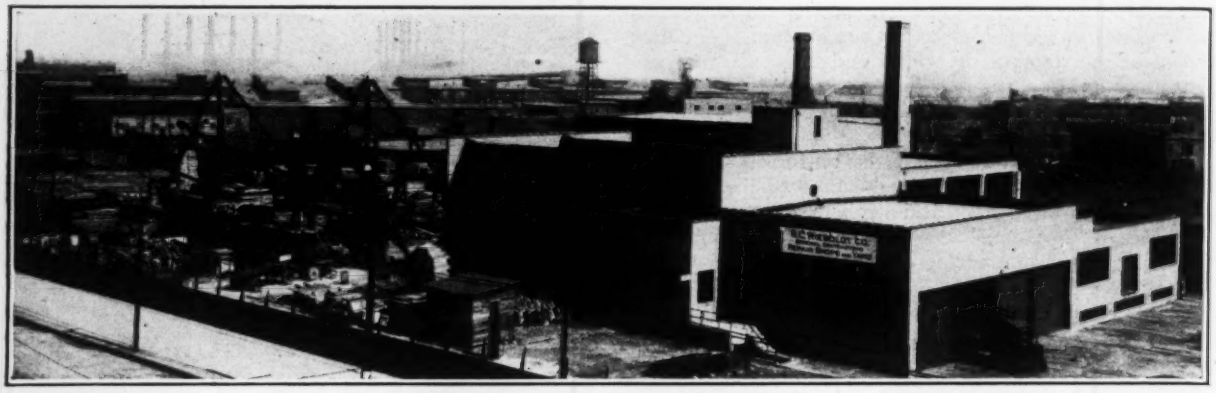


FIG. 1—CONTRACTOR'S STORAGE YARD AND REPAIR SHOP

While the layout was being planned, visits were made to several similar plants, but it was found that, with a few notable exceptions, the problem of plant layout had not been given much attention. It was considered, however, that a well-arranged yard with modern equipment, repair and handling facilities, would not only be convenient, but would effect much saving in the repair and handling of machinery and materials used in the company's construction work.

Buildings and Yard—The plant provides heavy machinery storage, machine shop, office, warehouse and loading space and platforms, besides toilet and wash rooms and other minor facilities. The arrangement of these units was governed by the following points: (1) Supervision; (2) handling and transfer of equipment between units; (3) receiving and loading equipment, machinery, tools and supplies by motor trucks and railway cars; (4) provision for expansion. Any unit can be expanded without interfering with others. Thus, the shop can be extended to the east, while the warehouse can be extended horizontally or vertically and other areas can be enlarged, so that any additions may conform to the original general plan.

The layout and design of the main buildings are shown in Figs. 3 and 4. All the buildings are fireproof, reducing the insurance charge to a minimum. The machinery storage, machine shop, office and loading units are of structural steel and one story high, except for a basement under the office and sorting space. This basement floor is level with the floor of the warehouse unit and contains toilet and wash rooms, a machinery room and a large storage vault for old plans and office records. The warehouse unit, of reinforced concrete, has a basement and first and second stories with floors designed for 200-lb. live-load.

Material Handling—To keep operation costs low and yet be able to take care of peak demands at minimum cost, study was made of the plant equipment required. For the machinery storage space, a 15-ton, 63-ft. overhead electric traveling crane, with a 5-ton auxiliary hoist for light loads, covers the entire unit and extends 200 ft. over the yard. This outside area is used mostly for storing lumber, and the crane has reduced the lumber handling costs about 80 per cent. That part of the machine shop for repairs to boilers and concrete mixers is covered by a 3-ton electric traveling crane, operated from the floor. One mechanic, with the aid of the crane, can handle a boiler from a hoisting engine or a drum from a concrete mixer. This crane also extends over the sorting or checking space and an areaway connected to the basement of the warehouse, so that pumps and other appliances can be wheeled directly under it and

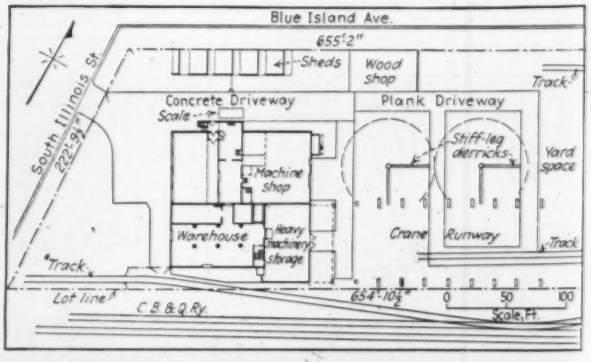


FIG. 2—LAYOUT OF CONTRACTOR'S YARD AND SHOP

carried to the machine shop or sorting space. On the same runway is a 5-ton hand-operated crane, so no time is lost waiting for crane service.

A 3-ton hand-operated crane serves the other half of the machine shop and also covers a balcony or mezzanine floor where electrical apparatus and motors are stored and tested. A platform on one side of this mezzanine floor is served by the 3-ton electric crane, which can handle motors directly from the mezzanine floor for shipment on trucks or cars. Half of the loading space is covered by a 3-ton, hand-operated traveling crane, which takes machinery and equipment directly from the truck to the loading platform. The warehouse has a 5-ton push-button control elevator with platform 8x15 ft. This is large enough to handle any equipment kept in the warehouse, besides taking gasoline concrete mixers, pumps and other machinery from the machine shop to any of the warehouse floors. Material in the warehouse is loaded on push trucks and can be rolled directly on the elevator. Hand moving of equipment or materials is practically eliminated.

Pipe Tunnels — To provide access to the numerous pipes in making repairs and connections, and to provide also for future additional pipes without cutting floors, all main piping is in tunnels. A tunnel with 6-ft. headroom leads from the boiler room under the warehouse to the end of the machinery storage space. Under the machine shop are three tunnels, one in the center with 6½-ft. headroom and one on each side of a lesser depth. Main electrical feeders for the various machines, together with their lighting wires, are located in the tunnels. With cut-out cabinet controls for the various machines, any machine can be shut off without interfering with the others. Leading from the tunnels underneath the machine shop are 3½-in. conduits, so that new equipment can be installed and connected to the wires without cutting the floors or running exposed conduit. The tunnel also contains feeders for wall plugs for electrical outlets on alternating and direct-current circuits used for testing equipment and for running portable drills or other tools. These tunnels also contain the compressed-air pipes, which terminate in outlets in various parts of the machine shop.

Electric Control — The electrical control system is located in the machinery room and is easily accessible from the machine shop. Its main panel board has one main switch controlling light and power. Leading from the main switch is a service switch, by which all circuits can be shut off, with the exception of those feeding the bilge pump, vacuum pump and night lights. Mechanics leaving the building at night shut off machine operation and general lighting by pulling this service switch. The air compressors, bilge pump and motor-generator unit are located in the machine room.

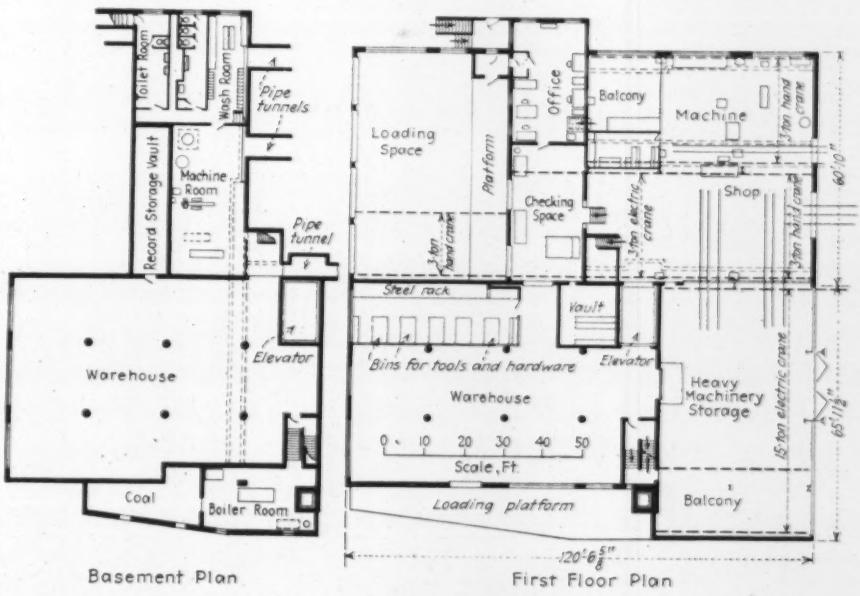


FIG. 3—GENERAL PLAN OF BUILDING

Plant Operation—The work at the new plant consists of repair of machinery and equipment; repair and sharpening of small tools; manufacture of such equipment as caisson rings, bull points and hoppers, as well as of small articles such as stone anchors; miscellaneous pip-

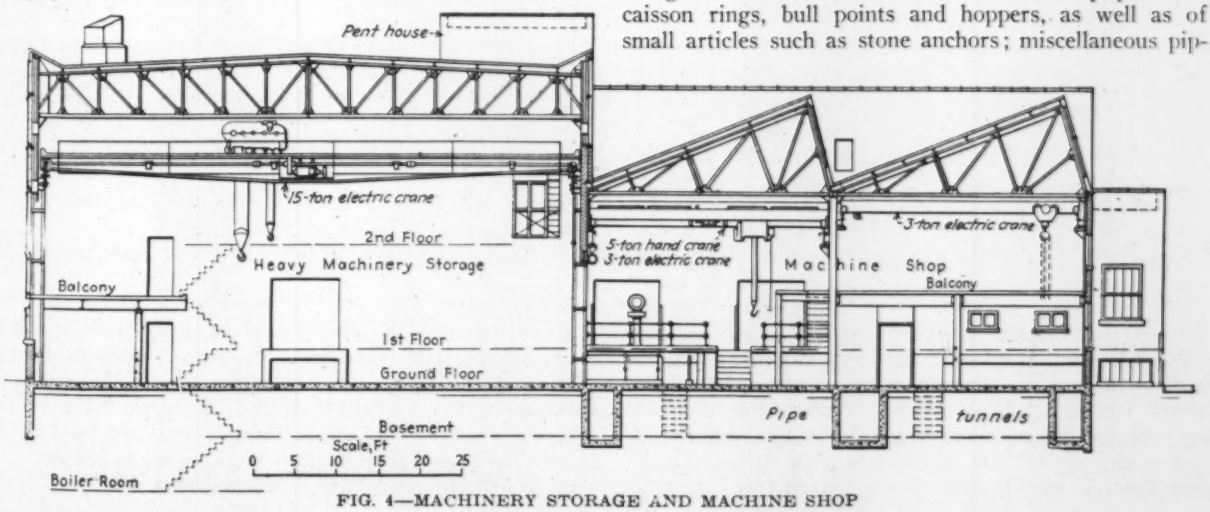


FIG. 4—MACHINERY STORAGE AND MACHINE SHOP

ing and light structural steel work. The company maintains a staff of mechanics who are sent out to make field repairs. Job forces are not permitted to go far with repair of equipment, as the plant can get a man on the job in a short time. A service truck to take care of these rush calls carries repair parts, jacks and tools.

A large stock of repair parts eliminates delay at the shop and also permits the field repairs to be made expeditiously. These parts are kept in steel racks, all labeled, together with tools and supplies used by the mechanics. All material is in steel bins and in charge of a stockroom keeper. On the second floor of the warehouse is a tarpaulin drying and repair room. About 1,000 tarpaulins are normally in use.

Lumber Storage and Handling—Usually from 500,000 to 1,500,000 ft. of second-hand lumber is on hand. This is handled mostly by the 15-ton crane. Lumber is graded and stacked according to size and is separated into units of about 5,000 ft., so that the crane can pick up a load from the pile and deposit it immediately on the truck or trailer. A truck can drive under the craneway, receive its load and leave in from three to five minutes.

As a considerable amount of lumber from the jobs is not suitable for use on other jobs, a saw mill is installed to cut this material into short pieces and wedges. The mill has an inserted-tooth saw, so that it can work on lumber containing nails. This saw, which handles lumber up to 8x8-in., will handle about 85 per cent of the material to be resawed, but the intention is to install another saw for larger timbers.

Machine and Equipment Storage—Hoppers, concrete buckets, buggies and chutes are stored under one of the 10-ton electric stiff-leg derricks. Provision is made for a future 10-ton 60-ft. electric traveling crane, parallel to the present 15-ton crane. With the yard space then covered by the two cranes, the stiff-leg derricks will be removed. Wheelbarrows, salamanders and similar appliances are stored in lean-to sheds north of the concrete driveway, with floors at truck level to facilitate loading and unloading. Two small hand-operated cranes facilitate the handling of heavy articles.

A limited stock of reinforcing steel at the yard enables a job to be started on short notice. Bar bending equipment is installed to take care of this material.

The company prefers to own rather than rent its equipment, in order to keep it under individual control. Record of the cost of repairing and maintaining each individual machine is kept, so that it can be determined whether it is cheaper to own or rent this machinery. Before any equipment is sent out to the job, it is tested and approved by the master mechanic, who is held responsible should any defects appear when it is put in use. Pumps are tested under approximate working conditions as to head and volume of water.

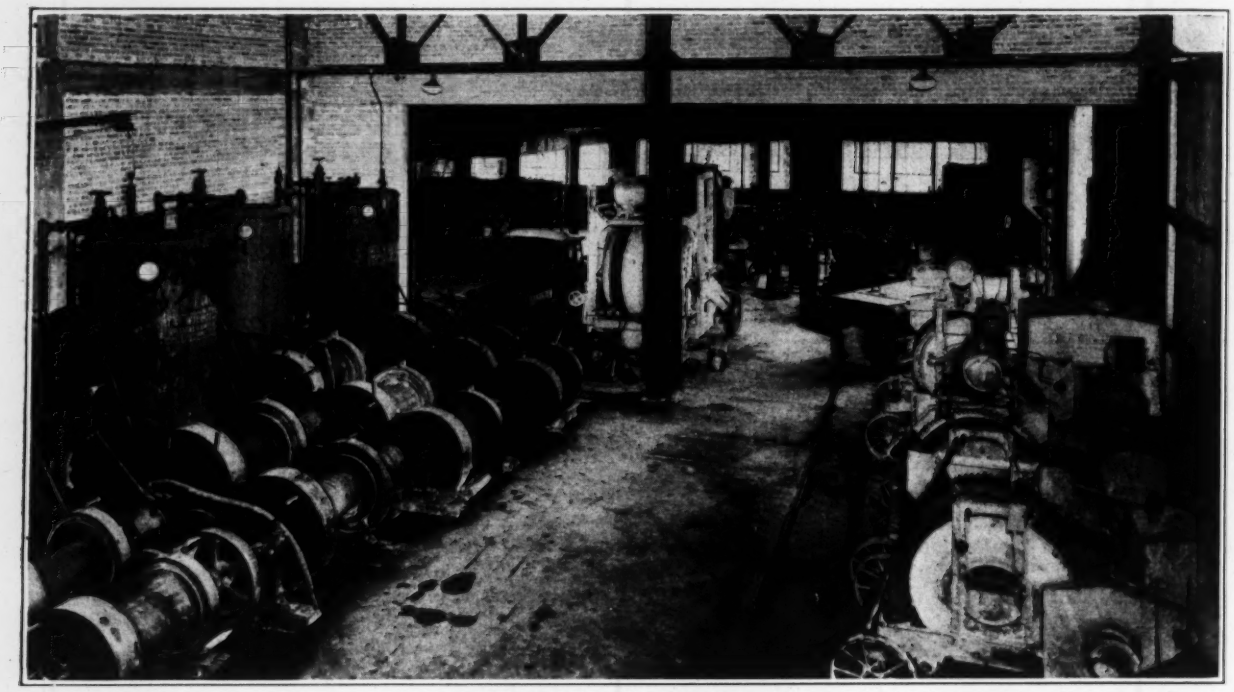


FIG. 5—STORAGE OF HEAVY MACHINERY
Steam hoists at left. Small concrete mixers at right. Large mixer in machine shop at rear.

It is proposed to install a wood-working shop for the manufacture of formwork. This will be particularly advantageous in connection with large jobs where there is limited storage room and where a comprehensive wood-working plant cannot be installed. Other improvements are planned to eliminate much work which is now done on the job but which can be performed more advantageously in the yard.

Work on this plant was begun Sept. 1, 1926, and the company occupied it on Dec. 1. In addition to the building construction, it was necessary to place about 3 ft. of fill over the entire area to bring it to street grade. The total investment in land, buildings and equipment (exclusive of construction plant and material for use on the various contracts) is about $350,000. All plans, and all structural, architectural and mechanical drawings for the buildings were made by the engineering department of the R. C. Wieboldt Co.

Settling Basin for Water-Works of Lawrence, Kansas

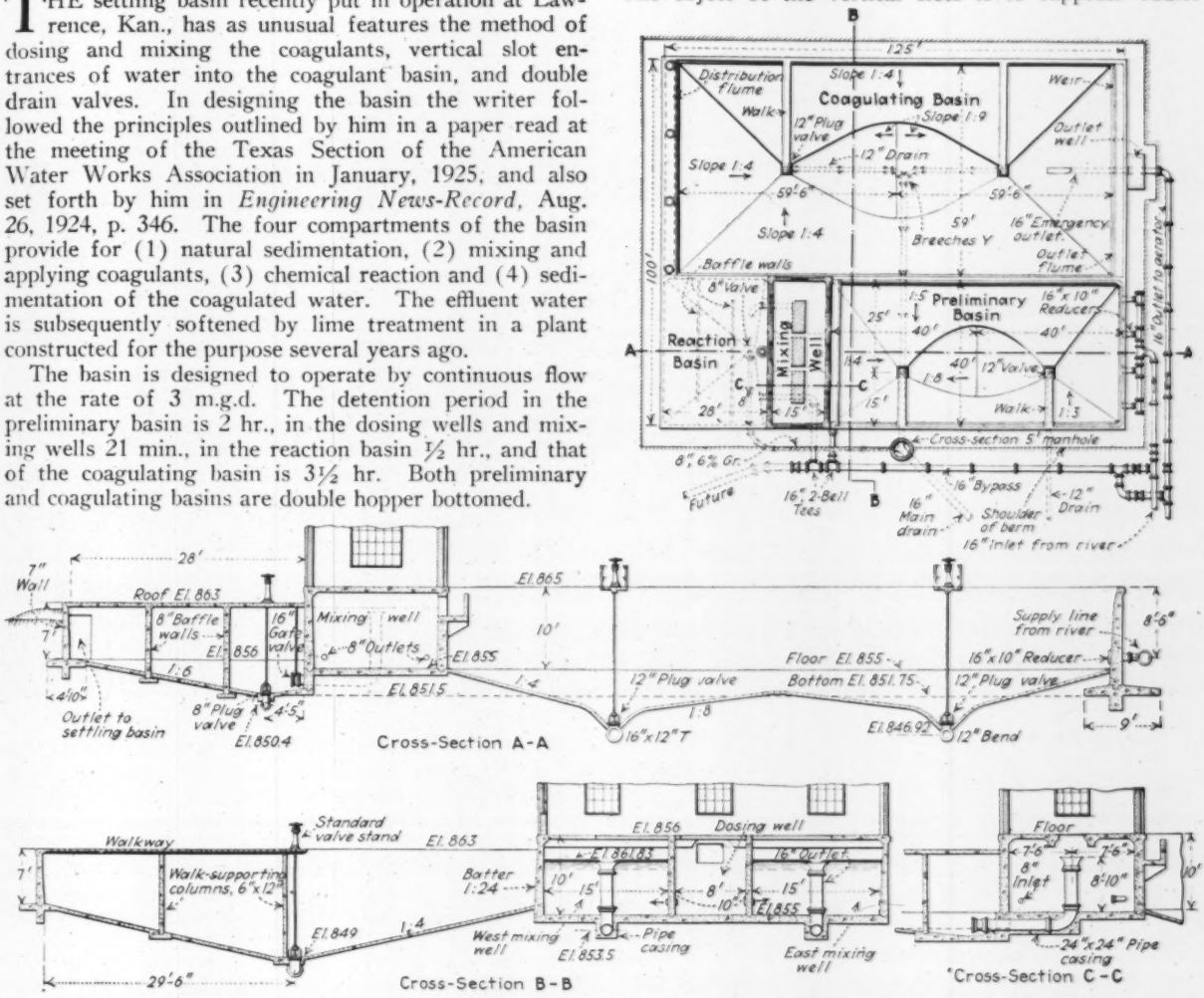
Preliminary Settling, Mixing, Reaction and Final Settling Compartments—Special Dosing and Coagulation Features

By Wynkoop Kiersted
Consulting Engineer, Kansas City, Mo.

THE settling basin recently put in operation at Lawrence, Kan., has as unusual features the method of dosing and mixing the coagulants, vertical slot entrances of water into the coagulant basin, and double drain valves. In designing the basin the writer followed the principles outlined by him in a paper read at the meeting of the Texas Section of the American Water Works Association in January, 1925, and also set forth by him in *Engineering News-Record*, Aug. 26, 1924, p. 346. The four compartments of the basin provide for (1) natural sedimentation, (2) mixing and applying coagulants, (3) chemical reaction and (4) sedimentation of the coagulated water. The effluent water is subsequently softened by lime treatment in a plant constructed for the purpose several years ago.

The basin is designed to operate by continuous flow at the rate of 3 m.g.d. The detention period in the preliminary basin is 2 hr., in the dosing wells and mixing wells 21 min., in the reaction basin ½ hr., and that of the coagulating basin is 3½ hr. Both preliminary and coagulating basins are double hopper bottomed.

The reaction basin is baffled. It discharges into the distributing flume of the coagulating basin through an opening of a size corresponding to the flow of the flume. The flume has a concrete cover, supplied abundantly with manholes and facilities for inspection and cleaning. Normally, water is delivered into the coagulating basin through a series of vertical slots 5 ft. high, with a width beveled outward from ½ to 2 in. For emergency use, in case the flume becomes clogged with deposits, a series of horizontal slots is provided above the vertical slots. The object of the vertical slots is to suppress eddies and surface currents, to induce parallel and uniform velocity flow, and to accelerate sedimentation.



PLAN AND SECTIONS OF NEW SETTLING AND COAGULATING BASIN FOR WATER-WORKS OF LAWRENCE, KAN.
Basin in four compartments which provide, successively, for presedimentation, coagulant mixing and dosing, reaction of coagulant and final sedimentation.

Raw river water is pumped into the preliminary basin through four horizontal, bell-mouthed cast-iron pipes slightly above the basin hopper level, and leaves the basin over a weir extending the full width of the basin into a trough communicating with the dosing well. Coagulants are applied to the water at the entrance with the dosing well from dry-feed machines. The coagulated water passes into the mixing well through two pipes at the bottom of the dosing well so directed as to induce a whirling upward circulation. It passes out of the mixing wells (used together or alternately) to a vertical downtake pipe concentric with the mixing well and communicating with the reaction basin.

The four main drain valves are of the plug type, 12 in. in diameter, one in the bottom of each hopper in each of the two large compartments of the settling basin. A 3-in. circular opening is drilled through the center of the disk of the main valve. This opening is reamed and faced at the top to form a seat for the machined nut on the lower end of the valve stem. On opening the valve the nut will lift 2 in. from its seat before engaging the yoke which lifts the main valve. This simple but effective contrivance permits drawing off the sludge without disturbing the main valve.

Tests on Stevenson Creek Dam: Deflections and Stresses

Results of 1926 Measurements at Various Heads Show Close Agreement with Design Calculations

By Fred A. Noetzli
Consulting Engineer, Los Angeles, Calif.

STEVENSON CREEK test dam (Fig. 1) was completed in June, 1925. The dam is 60 ft. high and has a length of 140 ft. on the crest. Its upstream radius is 100 ft., and its thickness 7.5 ft. at the base and 2 ft. at the crest. During 1926 thirteen water-load tests were carried out. Their results are summarized in the following. A diagram of deflections was published in *Engineering News-Record* of Nov. 18, 1926, p. 828.

During construction the dam was suitably equipped with instruments for measuring deflections, strains and temperatures. Forty days after the dam was completed the first test was made, with water 20 ft. deep in the reservoir. Subsequent tests were made with the water 30, 40, 50 and 60 ft. deep. All tests were made at night, usually between midnight and early morning, to minimize temperature effects.

Last November, after the test staff had moved to Los Angeles, a severe storm caused a flood which deposited so much rock débris in the reservoir that the undersluice was choked and the reservoir filled with water. The

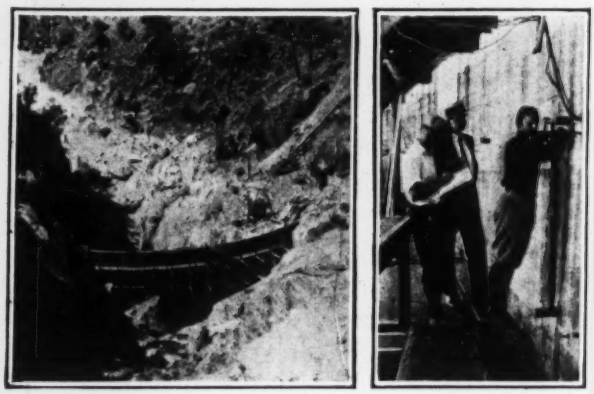


FIG. 1—TEST DAM AND TEST PARTY
At left, dam seen from above. At right, clinometer measurement of deflection.

depth of the débris at the upstream face of the dam is about 40 ft. At the height of the storm as much as 3 ft. of water poured over the crest. The observation platforms were carried away and the wiring of the electric telemeters was torn loose. Water continued running over the top of the dam all winter (Fig. 2).

Measurements—In the tests, deflections were measured on seven vertical lines, at points 5 ft. apart vertically, by means of a clinometer, to about 0.001 in. accuracy. Under full water load the dam deflected a maximum of 0.378 in., at a point of the arch crown 30 ft. below the crest; at the crest itself the dam deflected downstream at the crown, and upstream between the quarter-points and the ends.

When the water first rose to 30 ft., a horizontal crack between dam and foundation appeared at the center of the upstream edge. Its formation was first indicated by the unusual behavior of one of the electric tele-strain gages, which showed continuously increasing movement between dam and bedrock in spite of a stationary reservoir level. This gage finally went out of commission. During subsequent tests to higher heads, the opening of this crack was measured by means of a special electric instrument operating under water. An opening of the crack of 0.05 in. was recorded each time the reservoir was filled to the crest of the dam. Thus, one of the principal points of arch dam design discussed during recent years was cleared up in an unmistakable manner by one of the first load tests.

FIG. 2—WINTER OVERFLOW
Due to choking of outlet by storm.

Under a head of 50 ft. a vertical crack appeared on the center line of the dam, extending about 11 ft. down from the top. Under 60-ft. head, another vertical crack appeared on the downstream face of the dam on the vertical center line, extending 11 ft. up from the foundation (shown in Fig. 3).

Although the bedrock at the dam site is solid granite, a slight spreading of the walls of the canyon of about 0.03 in. due to the arch thrust was observed. These measurements were taken along the long chords at the 17-ft. and 33-ft. elevations, by means of an invar bar attached to a steel plug in the bedrock at one side of the gorge and bearing against an Ames dial fastened to a plug on the other side of the gorge. This spreading is plotted herewith (Fig. 4), for the different depths of water in the reservoir.

The strains in the dam were measured by electric tele-strain gages (telemeters), embedded in the concrete. On the surface of the dam, strains were measured by means of strain gages operated by hand. At elevation 30 ft., that is, midway between crest and bottom, a horizontal row of steel plugs 10 in. apart was set in the concrete, forming a continuous line across the dam.

Arch Stresses—The strains on the downstream face of the dam represent arch stresses for full reservoir

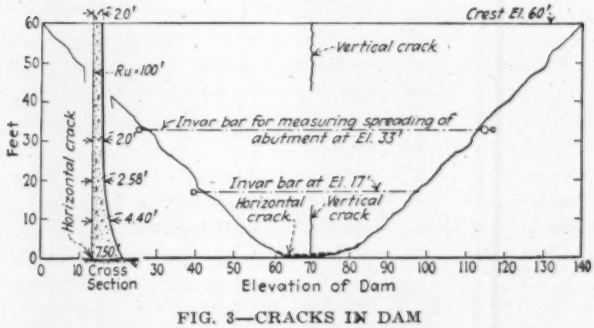


FIG. 3—CRACKS IN DAM

(based on a modulus of elasticity of 3,600,000 lb. per sq. in., as determined by laboratory and field tests) as shown in Fig. 5. The stresses at the downstream face were 260 lb. per sq. in. compression at the crown, and 900 to 1,000 lb. per sq. in. compression at the abutments. The

corresponding values calculated in the design were 207 and 879 lb. per sq. in. (See *Engineering News-Record*, May 14, 1925, p. 815.) The stress calculated by the cylinder formula for full water pressure at elevation 30 feet is 650 lb. per sq. in. uniform.

The plotted stresses just mentioned are total stresses (axial compression plus the bending due to rib-shortening). The bending stresses alone are shown by three curves in Fig. 5, as determined in three ways: (1) From the difference of strain on the upstream and downstream faces; (2) by double differentiation of the deflections; (3) from readings taken with the radius meter, which measured the change in mid-ordinate of a 40-in. arc of the dam. This change in mid-ordinate is proportional to the bending strain. The stresses by the three methods show surprisingly close agreement, except perhaps for the measurements with the radius meter. A heavy line is drawn to give the most probable value of the bending stresses as determined by the three methods.

Since the upper curves of Fig. 5 represent the sum of bending and the direct stresses, and the lower curves represent only bending stresses, their difference is the stress due to direct axial compression in the arch ring. This stress was nearly uniform throughout the length of the arch at this elevation, except in the immediate vicinity of the abutments.

Shears and Loads—For arch dams it is customary to divide the structure into elementary vertical elements, sometimes called cantilevers, and into elementary horizontal arches. From the observed data of deflections and strains in the Stevenson Creek dam, the moments and shears and the probable division of the water pressure between the vertical and horizontal elements have been obtained by repeated differentiation. Fig. 4 shows the deflections, moments, shears, and loads on the middle vertical element as deduced from deflections measured with the clinometer. The moments, shears, and loads carried by the horizontal arch elements at elevations 10 ft. apart were determined similarly.

The area between the vertical axis and the first curve represents the load carried by the vertical element as determined from the test data. The area between the first curve and the right-hand curve represents the load carried by the horizontal arch elements. It is of interest to note that these partial loads were determined independently from each other from the deflections and strains in the vertical elements on the one hand and in the horizontal arch elements on the other hand. Their sum must be equal to the total water pressure.

By way of comparison there is shown in Fig. 4 also the theoretical load division line for cantilever and arches.

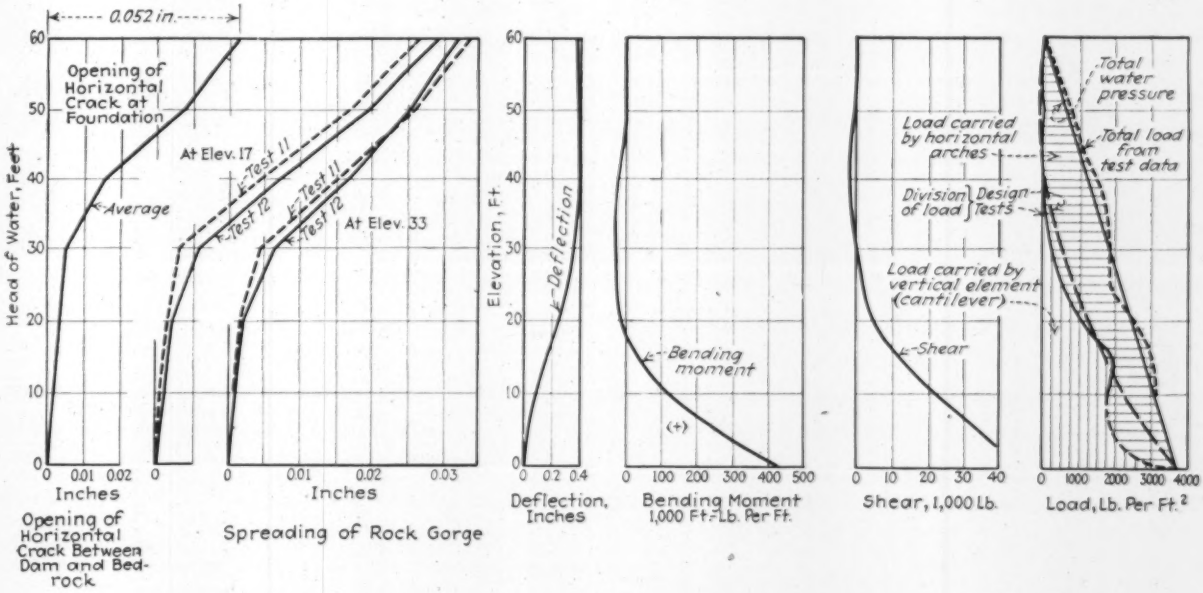


FIG. 4—BASE CRACKING, SPREADING OF ABUTMENTS, DEFLECTIONS, MOVEMENTS AND LOADS, FROM STEVENSON CREEK DAM TESTS

respectively, as determined in the original design of the dam in January, 1925. Apparently the test dam under full load carried slightly less water load by the vertical elements than was found in the original design. One explanation of the discrepancy may be found in the horizontal crack at the foundation. The summation of loads carried by the vertical and horizontal elements, respectively, shows quite remarkable agreement with the total water pressure triangle. For the 5-ft. and 10-ft. elevations the loads determined for the vertical elements are in doubt. The load at the bottom is shown as the total water pressure.

Tests on Small Models of Dams—Experiments on the full-sized test dam on Stevenson Creek have furnished such surprisingly accurate results that the Committee on Arch Dam Investigation was induced to carry the investigation one step further and undertake the testing of small models of arch dams. Such tests of small models are being undertaken at Boulder, Colo., by a sub-committee with the co-operation of the U. S. Bureau of Reclamation and the University of Colorado. A small model of the Stevenson Creek test dam will first be tested and if the results show a fair agreement with

the data obtained on the full-sized dam, models of other types of arch dams will be tested similarly.

An independent check on a model of the Stevenson

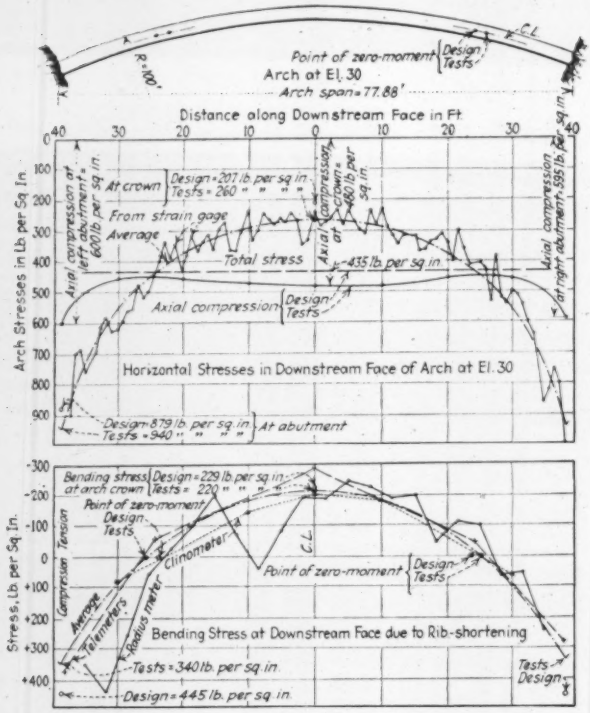

Point of zero-moment
Design
Tests
Arch at El. 30
Arch span = 77.88'
R = 100'
C.L.
Distance along Downstream Face in Ft.
Arch Stresses in Lb. per Sq. In.
Axial compression at left abutment = 600 lb. per sq. in.
At crown
Design = 207 lb. per sq. in.
Tests = 260 " " " "
From strain gage
Average
Total stress
Axial compression = 480 lb. per sq. in.
= 435 lb. per sq. in.
Axial compression at right abutment = 595 lb. per sq. in.
Axial compression
Horizontal Stresses in Downstream Face of Arch at El. 30
Design = 879 lb. per sq. in.
Tests = 940 " " " "
At abutment
Bending stress at arch crown
Design = 229 lb. per sq. in.
Tests = 220 " " "
Point of zero-moment
Clinometer
Radius meter
Average Timmerle's
Stress, Lb. per Sq. In.
Compression
Tension
Bending Stress at Downstream Face due to Rib-shortening
Tests = 340 lb. per sq. in.
Design = 445 lb. per sq. in.
Tests
Design

FIG. 5—HORIZONTAL ARCH STRESSES IN DAM

Creek dam, built of celluloid, is being made at Princeton University with the co-operation of the Power Division of the American Society of Civil Engineers.

Convict Road Workers May Collect Compensation Insurance

THE California Supreme Court has ruled that under the present laws in that state, prisoners employed in the construction of highways come within the provisions of the Workmen's Compensation Act and in case of injury are entitled to compensation from the state. A test case was recently fought through the courts on Robert Smith, a negro, who was blinded by a blast on the Merced Canyon road project which was built by prison labor. As a result of this decision the state is planning to take out additional insurance for prisoners in road camps.

After completing his sentence, Smith applied to the Industrial Accident Commission for disability benefits, and the Commission awarded him the sum of $791.52 for permanent disability, a weekly payment of $7.76 for 138 weeks, and thereafter $4.79 for the remainder of his life. This award was affirmed by the court. Essential features of the court's decision are given in the following:

The sole question here presented is whether or not a convict engaged in the performance of labor on a state highway under the provisions of chapter 316 of the laws of 1923 (California) is an employee within the meaning of the Constitution and Workmen's Compensation Act.

There is no provision either in the organic law or the statutes which directly includes or excludes them as such. The question, therefore, concerning what relationship exists between the state and an incarcerated convict so employed on the highways involves the proper construction to be given to the various laws relating to the subject. . . .

The Convicts Road Camp Bill provides among other things that the State Highway Commission may employ or cause to be employed on the highways of the state certain convicts confined in the state prisons, and that when so employed such convicts shall receive a specified compensation not exceeding seventy-five cents net per day for their labor.

Provision is also made for authority of the prison directory to send the number of convicts to a prison camp as may be requisitioned by the commission. Under these conditions it is respondents' claim in the support of the award that this act entirely changes the status of convicts who may be assigned to work on the highways, and creates a new class of paroled prisoners between whom and the state a relationship is created, one of the incidents of which is a liability under the Workmen's Compensation Act for injuries.

Respondents seem to concede that while engaged in work within the prison walls, this claimed relationship does not and cannot arise, but they insist that there is logically and necessarily a real, definite and distinct difference between the status of a convict *within* and one *without* the prison walls performing work upon the highways under the provisions of the act in question, that as to the latter it was the intention of the legislature as evidenced by the use in the act of the words "employ" and "employment" to authorize the State Highway Commission to enter into a contract of employment with convicts released for such work. We are of a like opinion. . . .

The power . . . to deprive a prisoner of his civil rights is one that resides in the legislature. The power to thus deprive a prisoner of such rights must include the corresponding power to restore them. This we think was the manifest intention and purpose of the Convicts Road Camp Bill. The legislature is in keeping with the modern idea that it is for the benefit of society to rehabilitate those possessing criminal instincts, and one of the means employed is to partially restore to them their civil rights to contract for their labor as an encouragement to that end, the act so expressly indicates, for it provides by the very first section thereof that the "State Highway Commission may employ or cause to be employed, convicts confined in the state prisons, etc." . . . The word "employ" has a definite legal meaning and legal terms when used in a statute are to be construed according to the context and the approved usage of language unless a different sense is obviously intended.

We conclude, therefore, that under the terms of the Convicts Road Camp Bill the legislature intended to restore to a convict assigned to work upon the public highways such limited civil rights as are necessary to create the relation of master and servant between him and the State Highway Commission, and this being so, he must be held to be an employee within the meaning of the Workmen's Compensation Act. It follows that the applicant is entitled to all the benefits of this act and the Industrial Accident Commission was correct in so concluding.

For the reasons given the award is affirmed.

Subaqueous Tunnel Diameters

It was stated in the article describing the ventilating system of the Holland vehicular tunnel at New York in our issue of June 9, p. 935, that the portion of the tunnel having an external diameter of 30 ft. 4 in. was the largest subaqueous tunnel in the world. This statement is incorrect. It is the largest shield-driven subaqueous tunnel. The Oakland estuary tunnel in California, which is being built by the trench method, with precast concrete sections, has an external diameter of 37 ft. The internal diameters of these two tunnels are 27 ft. 8 in. for the large section of the Holland tunnel and 32 ft. for the Oakland tunnel.

Effects of Calcium Chloride on Road Slab Concrete

Integral and Surface-Applied $CaCl_2$ Behavior Disclosed by Cylinder and Beam Tests and Crack Survey

By H. P. Olson

Division of Materials Engineer, Department of Highways, Nashville, Tenn.

IN 1926, the Tennessee Department of Highways, built 6.686 miles of calcium chloride-cured concrete pavement. Part of the project was constructed with an admixture of 2 per cent calcium chloride, which was supposed both to cure the concrete and to give it a high early strength. The rest of the job was cured by applying 2.5 lb. of calcium chloride per square yard of surface after the concrete had set.

At the time of the change from calcium chloride incorporated to calcium-chloride surface curing, a series of cylinders and beams was made. After the concrete had been dumped on the subgrade it was shoveled into the beam and cylinder forms and uniformly tamped. A total of seventy-five 6x12-in. cylinders and twelve beams each 6x6x46 in. were made. Twenty-six of the cylinders and 4 of the beams contained no calcium chloride, 24 of the cylinders and 4 of the beams were made with an admixture of 1 per cent of calcium chloride, and 25 of the cylinders and 4 of the beams were made with an admixture of 2 per cent of calcium chloride. The cylinders were broken at the ages of 7 and 28 days. The beams were broken at the ages of 7 days, 28 days and 3 months. Each beam was broken at each of these three ages. The cylinders containing no calcium chloride and broken at 28 days were cured in a moist closet. All other cylinders and beams were left in the open air until broken. The average results were:

No $CaCl_2$	1 P.C. $CaCl_2$	2 P.C. $CaCl_2$
	6 x 12-in. Cylinders	
	7 Days	
2,277 lb.	2,090 lb.	2,292 lb.
	28 Days	
3,223	2,584	2,465
	6 x 6-in. Beams	
	7 Days	
407	377	383
	28 Days	
555	479	482
	3 Months	
804	673	672

The results indicated: (1) That the averages of the 7-day cylinders are about the same for all three cases.

(2) That the averages of the 28-day cylinders are about the same for one per cent and two per cent of calcium chloride incorporated and are approximately 700 lb. lower than the average of the plain concrete.

(3) That the gain in strength from 7 days to 28 days is: 2 per cent, 173 lb.; 1 per cent, 406 lb.; none, 946 lb.

(4) That the beams containing no calcium chloride average considerably higher than those containing calcium chloride.

(5) That the gain in strength from 7 days to 28 days is: 2 per cent, 99 lb.; 1 per cent, 102 lb., and 0 per cent, 148 lb.; and the gain from 7 days to 3 months is: 2 per cent, 289 lb.; 1 per cent, 296 lb., and 0 per cent, 397 lb.

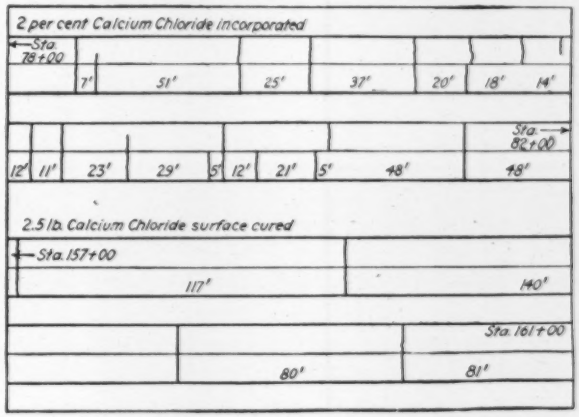
During the progress of the work 6x12-in. cylinders were made, usually in pairs, one to be broken at the age of 7 days and the other at 28 days. The cylinders containing no calcium chloride were not cured in any way, being stored in a hall in the laboratory until due to be broken.

The results were: with no calcium chloride: 7 days average of 18 tests, 1,783 lb.; 28 days average of 21 tests, 2,394 lb.; with 2 per cent added calcium chloride: 7 days, average of 7 tests, 2,116 lb.; 28 days average of 31 tests, 2,321 lb. It will be noted:

(1) That the cylinders containing no calcium chloride show a gain in strength, from 7 days to 28 days, of 576 lb., while those containing 2 per cent calcium chloride show a gain of 104 lb. in the same length of time.

(2) That the average of the 7-day cylinders containing calcium chloride is slightly higher than the average of those containing no calcium chloride, but the 28-day average is lower than the 28-day average of those containing no calcium chloride and not cured in any way.

After the road was completed cores were drilled from the slab and broken at various ages. Of these, 47 cores



CRACK SURVEY OF CALCIUM-CHLORIDE INTEGRAL AND SURFACE-CURED PAVEMENT

were drilled from the slab containing 2 per cent calcium chloride and 23 from the surface-cured slab. Results were:

	Surface Cured		Incorporated	
	Age in days	Strength	Age in days	Strength
Average	95	3,447	107	2,920
Maximum	125	4,199 (108 days)	215	4,149 (137 days)
Minimum	53	2,320 (53 days)	44	1,760 (63 days)

The surface cured cores have a much higher average strength and a smaller variation in strength than the calcium chloride incorporated cores.

During January, 1927, a survey was made to determine the condition of the slab. Any crack extending entirely across the pavement whether continuous or offset at the center joint by 10 ft. or less was called a temperature crack. Any crack other than a temperature crack was called a miscellaneous crack. These included corner breaks and transverse cracks extending across only half of the slab. Any unbroken portion of pavement slab as between two construction joints, two temperature cracks or a joint and a temperature crack was called a section. The following results were obtained:

	1 P.C. $CaCl_2$	2 P.C. $CaCl_2$
Average length of section	108.3 ft.	52.6 ft.
Feet of cracks per 100 ft. of slab	11.76	33.05
Feet of temperature cracks per 100 ft. of slab	11.6	29.5
Feet of miscellaneous cracks per 100 ft. of slab	0.16	3.55

The center line crack is a construction feature and is not considered in the linear feet of cracks. The chart shows a portion of both of the calcium chloride incorporated and the surface cured concrete. The figures represent the length of each unbroken section.

From Job and Office

Hints That Cut Cost and Time for the Contractor and Engineer

Intermittent Lime Feed Plan Reduces Incrustation from Softened Water

By L. C. Billings
Superintendent of Filter Plant, Grand Rapids, Mich.

BY ADOPTING the intermittent lime-treatment plan, Grand Rapids has materially reduced the rate of carbonate incrustation in the mains from lime-softened water. This plan also permitted a reduction in the amount of lime fed.

The natural river water hardness of 14 gr. per gal. is reduced about 50 per cent by intermittent lime treatment in a 40-m.g.d. filter plant. This method of treatment accomplishes the same results as does the "split treatment" method, although the resulting water is from 2 to 3 grains harder than under the full lime-treatment plan. The normal carbonates are kept at a lower concentration and better coagulation results than if the same dose of lime were added continuously. With the intermittent plan it is possible to reduce the lime fed to any desired amount.

CARBONATE LINING ON 48-IN. CONCRETE CONDUIT

At this plant it is found satisfactory to feed sufficient lime to reduce the total hardness about 50 per cent. When sufficient lime is added to remove all of the bicarbonate hardness from the water, it results in a supersaturated solution of calcium carbonate which readily deposits the carbonate on filter sands, conduits and the mains. The sulphate hardness of the water averages 2.7 gr. per gal. which is slightly increased by the use of alum as a coagulant.

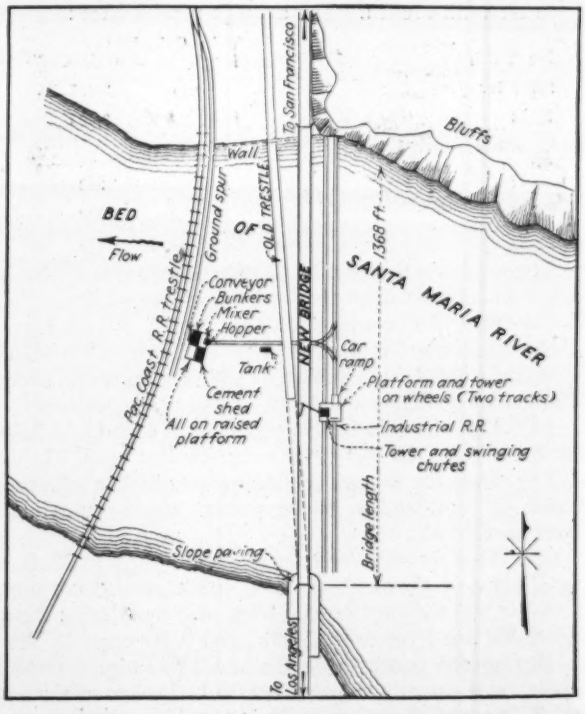
The accompanying picture shows a cross-section of a 48-in. reinforced-concrete filtered water conduit at the filter plant. This conduit has been in service since 1913 and the 13 years of continuous use have produced a carbonate lining $\frac{5}{16}$ in. in thickness. Cast-iron mains throughout the distribution system are similarly lined, ranging in thickness from a thin film to a lining $\frac{1}{4}$ in. in thickness. During 1926, 12.4 per cent of the meters removed for repairs were either stuck by the carbonate coating or made inoperative because of loose scale. There has been some trouble from incrustation in hot water systems, but this condition has been reduced somewhat by the intermittent treatment. However, there is still some deposition of carbonate scale, particularly at points in the distribution system where the velocities are low and in some hot water systems.

Studies are being made to determine the effectiveness of carbonating the settled water with CO_2 in order to remedy these conditions.

Ingenious Plant Layout for Concreting a Highway Trestle

A COMBINATION of a stationary mixing plant, narrow-gage railway delivery and traveling tower and chute distribution solved the problem of concreting a pile trestle, 1,368 ft. long on the Coast Highway near Santa Maria, Calif. The trestle consists of 36 four-girder spans 38 ft. long carried on 6-pile bents, all of reinforced concrete.

The length of the trestle presented the chief problem in plant layout. The accompanying diagram shows how it was solved. A spur was run from the Pacific Coast R.R. to the center of the river bed where bins and a mixing plant were constructed. Aggregates were unloaded from cars to bins by a bucket elevator and cement in bags was unloaded from flat cars into the cement house by a small car operated by a cable and hoist. The bins chuted directly into measuring buggies which charged a 2-bag open-tilting mixer. This mixer discharged into a storage hopper which fed into a $\frac{1}{3}$ cu.yd.



CONSTRUCTION PLANT LAYOUT FOR LONG CONCRETE TRESTLE

car operating on a narrow gage track about at right angles to the bridge line. At the bridge this track forked and paralleled the bridge. The locomotive was a home-made contrivance of a gas engine and Ford and Chevrolet transmissions.

On the parallel service track and a second track alongside, was a platform on wheels carrying a tower and a boom chute. Cars of concrete from the mixer were pushed up the ramp on the tower carriage and dumped into the tower skip. A gas engine hoist operated the skip. By moving the tower carriage along the work any part of the bridge could be concreted by direct chuting. The contractors were Rocca & Caletti, of San Rafael, Calif., and J. C. Wilson and H. E. Fearnall were resident engineers for the bridge department of the California Highway Department.

Traveler Is Convenient in Placing Sections of 64-In. Pipe

By W. A. Kunigk
Superintendent, Water-Works, Tacoma, Wash.

THE type of traveler shown in the accompanying picture has been used several times by the water department of Tacoma, Wash., in laying or rebuilding pipe lines where the grade was not accessible for derrick or crane work. The traveler in the picture is

PLACING A 64-IN. PIPE SECTION IN THE TACOMA WATER SYSTEM

handling a 30-ft. section of lockbar steel pipe, 64 in. in diameter on side-hill construction where the pipe line was supported on concrete piers because of sliding ground. With the arrangement shown, it was possible for the men operating the winches to absolutely control every movement of the pipe in the process of assembling. This method of handling large pipe has been found speedy and safe and has given very satisfactory results on our work.

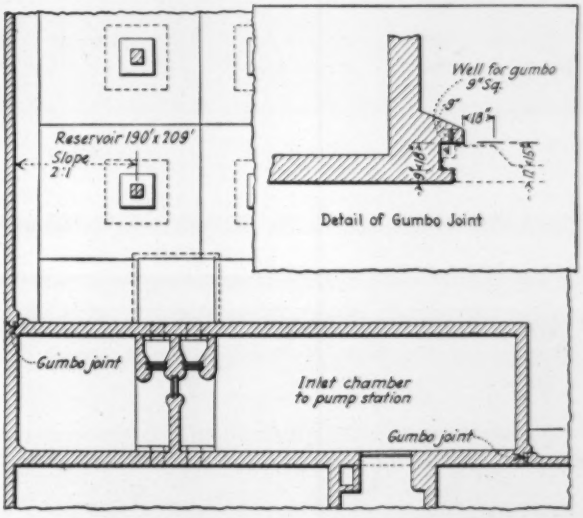
The hand winches at either end of the traveler pick up and hold the pipe section in position during its journey and are also used to tilt the pipe when making the assembly with the preceding section. When laying pipe on a steep slope a third hand winch is used, fastened to the top of the traveler and the bridle is passed through the lead blocks on the traveler and through a snatch block in the holding line.

The man operating the hoist at the top of the hill lowers the traveler and pipe to within about 6 in. of its proper position for making the connection. The manipulation of the pipe itself is then handled by the winches. The type of winch used is an all-steel, 5-ton hand hoist with two speeds—1,500 lb. capacity on a 1:4 ratio, and 10,000 lb. capacity on a 1:24 ratio. The weight of these winches is 110 lb. each. The spreader timbers shown below the bottom of the pipe are loose and are removed when the pipe section is to be lowered.

Packed Gumbo Joints in Concrete Reservoir Prevent Leakage

AN UNUSUAL feature incorporated in the design of the city distributing reservoir on the new Amarillo, Texas, water-works, described in *Engineering News-Record*, June 2, 1927, p. 904, is the use of packed gumbo in making joints between the concrete slabs on the slopes and bottom of a distributing reservoir. Gumbo was also used to prevent leakage at the expansion joints where the reservoir walls are connected with the walls of the pumping station. A detail of the latter joint is shown in the accompanying illustration. Each joint holds a column of gumbo 9 in. square and 11 ft. high.

The reservoir is approximately 200 ft. square and of reinforced concrete with a concrete roof and hopper-shaped bottom. The bottom slopes from about half the height of the side walls to the center of the outside row of roof columns. The 4-in. concrete slabs on both the flat and sloping bottom rest on 12 in. of clay puddle. The joints between the slabs are tapered from a width of about ¼ in. at the top to ½ in. at the bottom. A depth of about 1 in. in the bottom is



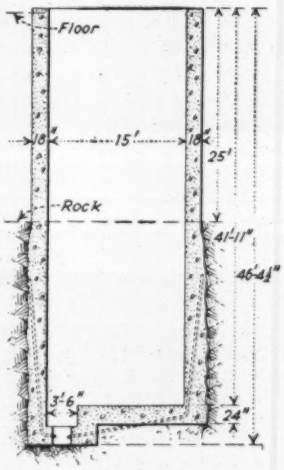
GUMBO EXPANSION JOINT BETWEEN RESERVOIR AND PUMP STATION WALLS

filled with calking yarn, the remainder of the joint being packed with gumbo rammed and compacted with a wooden mallet. The Amarillo water-works were designed by Wynkoop Kiersted, consulting engineer, Kansas City, Mo., who has also used gumbo to pack 2 to 4-in. annular spaces around pipes passing through concrete walls. This practice has prevented breakage from settlement and has provided satisfactorily for expansion and contraction.

Removing Seepage Water During Building of Deep Dipping Tank

By R. D. Stephens
J. W. Hansen, Contracting Engineers, Pittsburgh, Pa.

IN CONSTRUCTING the concrete portion of a dipping tank recently completed for the Witt Steel Co., South Greensburg, Pa., some unusual problems were met and solved. At 25 ft. below ground elevation rock was encountered which continued to the maximum depth of the pit. This rock was seamed and fissured and from all crevices water issued, varying in volume from a gush with considerable pressure behind it to a steady drip. To take care of flows, sections of pipe were placed so as to connect sources of water in the rock wall with a small secondary sump, both pipe and sump being shown on the sketch herewith reproduced. Four such pipe sections were placed in positions so as to be covered with concrete when poured and a steam pump was lowered to the bottom of the pit and operated day and night. Since the pit had to be watertight, the engineers specified a 1:1½:2 concrete and a 5-min. mix with continuous pouring. The concrete was mixed as dry as possible.



PIPE PLACEMENT IN DIPPING TANK

The floor of the pit was poured and before the concrete had set, a circular form handled by hoist and gin pole rigging was placed in position and the pouring of the wall commenced. After all concrete had been poured and permitted to attain a set sufficient to withstand the water pressure the pipes leading into the secondary sump were plugged, save one which was brought to a higher elevation, capped, and left exposed. The secondary sump was then concreted and the job finished, a water-tight concrete tank having been obtained and no waterproofing compound was used.

The designing engineer was George F. Dillig of Pittsburgh, and with him was associated J. W. Hansen, also of Pittsburgh. Fred Bruner Co., Pittsburgh, was the contractor, and John Walker was superintendent of construction.

Locating Stub Connections in Sewers

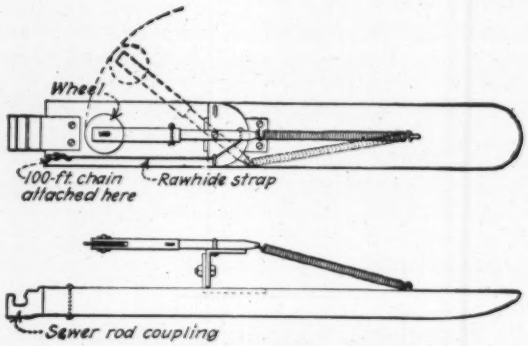
By William F. Terry
Division Engineer, Sewerage Commission, Milwaukee, Wis.

VERY GOOD results have been obtained in locating stub sewer connections in small-sized sewers in Milwaukee by means of a simple device developed by J. Ellmaurer, engineer of the sewerage commission, and the writer. Various methods were employed in relocating these connections in an attempt to save time and labor before the method of using this device was adopted.

Provision is made to couple it to sewer rods so that it can be pushed back and forth through the main sewer. An arm is made to ride against the side of the sewer and enters the connection when pushed or pulled past it. The exact distance to the connection is then determined

From Job and Office

Hints That Cut Cost and Time



DETAIL OF LOCATING DEVICE

by means of a steel tape which is attached to the device.

A piece of wood, preferably hardwood, 2x4x30 in. in size, is shaped like a boat so as to slide easily along the inside of the sewer. A sewer rod coupling is fastened to one end of this piece and the device itself is mounted on top of it, as shown in the accompanying sketch.

In use, the device is coupled to sewer rods and pushed into the sewer after first having attached the steel tape and adjusted the arm by means of the bolt so that it will rotate in a plane parallel with the line of the connection. It is then pushed a little beyond the probable location of the connection and slowly withdrawn, pulling on the steel tape at the same time to cause the wheel mounted on the end of the arm to ride along the side of the sewer. As soon as the wheel reaches the connection, it will roll into it preventing the device from being pulled any further. The distance to the connection can be measured directly from the steel tape. By pushing the device ahead into the sewer and at the same time releasing the tension on the tape, the arm will move back into its original position and permit withdrawal from the sewer.

Arms of various lengths can be attached for use in different sized sewers.

Mud and Snow Road Heavy Haulage Done by Crawler Tractors

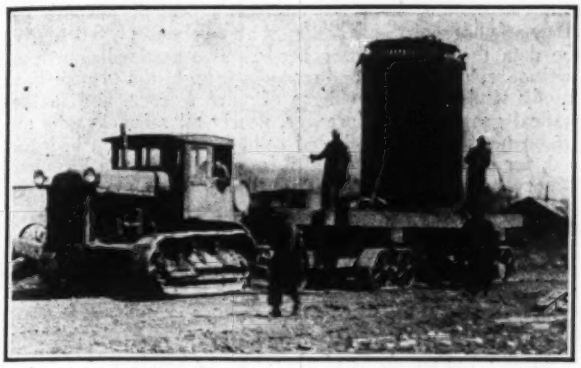
By N. F. Helmers
Slems, Helmers & Schaffner, General Contractors, St. Paul, Minn.

IN BUILDING two small hydro-electric power plants on the Menominee River, about 25 miles above Menominee, Mich., during last fall and winter, one of the most important problems was the freighting overland of all contractor's equipment, material and supplies, as well as the water-wheels and generating equipment. The length of haul was approximately seven miles from the Wisconsin & Michigan R.R. to the Chalk Hill camp, and approximately six miles to the White Rapids camps. The highway was to a large degree new grade and had practically no gravel surfacing. The contract required the work to be completed by April 22, 1927.

From the beginning of the work and until snowfall freighting was done by 10-ton crawler tractors and truss-wheeled wagons of 10-ton rated capacity, and 5-ton

From Job and Office

For Contractor and Engineer



TRACTOR HAULING 22-TON TRANSFORMER ON COUPLED TRUSS-WHEEL WAGONS

roller-bearing trailer wagons. A small amount of continuous freighting was also done by trucks which furnished an elastic unit which could be dispensed with when desired. They could not be used in wet weather.

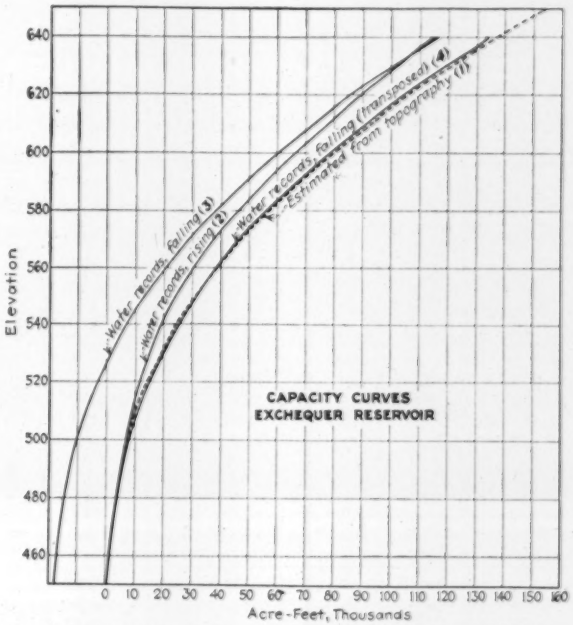
After the setting in of winter, the crawler tractor continued operation, hauling two and three heavy logging sleighs with 10 to 14 tons per sleigh. In connection with this hauling equipment, the regular load on the truss-wheel wagons has been from 10 to 12 tons and for a greater part of the time two wagons were hauled by one tractor, and, depending on the character of the load, two or three roller-bearing trailer wagons hauled in one train with approximately five tons per wagon. Special machinery loads have been made up at different times aggregating as much as 28 tons. The view shows two truss-wheel wagons close-coupled for handling a 22-ton transformer which stands 17½ ft. above the wagon bed.

During the spring break-up, this road was impassable even for Ford cars, but at no time was the crawler and truss-wheel wagon unit unable to function, and the work has at no time sustained any delay of any nature through the item of overland haulage. The power plants are being built by Northern Electric Co., Green Bay, Wis.

Capacity of Exchequer Reservoir Checked by Flow Record

By Daniel McFarland
Storrie, California

DURING the construction of Exchequer dam in California careful estimates of the capacity of the reservoir were made from the topographical map and a curve was plotted to show the capacity at various elevations. This curve is shown as No. 1 on the accompanying drawing. In April, 1926, when water storage was begun, checking the estimated capacity of the reservoir was undertaken. For this work two gages which had been in operation for several years and had fairly accurate rating curves were available, one in the Merced River below the dam and one in the river upstream above the high water line of the reservoir. With these two gages giving the inflow and outflow from the reservoir curves 2 and 3 were plotted. No allowance for



CAPACITY CURVES OF EXCHEQUER RESERVOIR

evaporation was made in constructing curve 2 for rising gage heights. In the construction of curve 3 an evaporation of 1 ft. over the average surface area was allowed during the months of June, July and August.

Curve No. 4 represents curve No. 3 shifted over to the same point of origin as curve 1 for comparison. This shows that the estimated capacity checks closely with the capacity obtained from the record of water drawn from the reservoir. The discrepancy between curves 2 and 3 seems to indicate some inaccuracy in the gage above the reservoir.

Job and Office Notes

Under a plan developed by the State Highway Engineer of Wisconsin all reinforcing steel shipped to highway work will be tested at the warehouse or mill. It is believed that it is as important to test the steel as to test cement, and the work will be handled through several agencies with which agreements have been made. Metal culverts are inspected before shipment from the factory, and the engineer states that this inspection service has done much to improve the quality of the corrugated metal culverts sold in Wisconsin. Each culvert has an inspection seal attached. This service has met with approval by the counties, many of which specify, when calling for bids, that the culverts must be inspected at the factory.

Use of Liquid Oxygen as an Explosive in strip coal mining, which may suggest something to contractors doing quarry stripping, is given in a paper by George B. Holderer, New York, N. Y., presented to the American Institute of Mining and Metallurgical Engineers in February. Operations of the Enos Coal Mining Co. in southern Indiana which include a plant for the manufacture of liquid oxygen at the mines are given in detail. The explosive is made by taking cotton bags, 4½ in. in diameter and 18 in. long, filling them with carbon and soaking them in the liquid oxygen. When fully soaked the bags weigh 12 lb. They are then fired similarly to black powder or dynamite. An important feature of safety lies in the fact that only 1,000 lb. of liquid oxygen explosive are on hand at any one time, as it is manufactured on the premises as used. Previously it was necessary to ship in and store considerable quantities of explosive.

Letters to the Editor

A Forum for Discussion of Views of Engineers and Contractors

Earthquake Data for the Structural Engineer Through Improved Seismology

Sir—I am greatly interested in the response by Commander Heck, p. 984 of your June 16 issue, to my recent remarks to the effect that the broken chimneys and the cracked walls remain the only instruments for giving the structural engineer data upon the forces exerted by earthquakes, while seismographs are designed almost exclusively for the use of geophysicists and students of isostasy and of the velocity of transmission of elastic waves from great distances through the earth.

The facts in the case I believe to be as follows, and the matter is one of highest importance to the structural engineer—and, as Commander Heck well says—the engineers have not been interested sufficiently in this matter of the information that they need from the observatories and geophysicists.

History shows that sooner or later, an earthquake of intensity IX or X on the Rossi-Forel scale may occur almost anywhere. Experience proves that buildings can readily be designed to withstand such shocks in nearly all situations. It is important to attain safety with maximum economy of design. The structural engineer for this purpose desires to know the magnitude of the forces set in action by an earthquake which may shake the proposed building back and forth and up and down.

The earthquake shock comes ordinarily in the form of a series of elastic waves, moving back and forth within a period of from a quarter second to two seconds, with a maximum amplitude of from ¼ in. to 2 in. horizontally, irregularly in any direction, and commonly of not more than a quarter of this amplitude vertically. Each series of vibrations commonly lasts for not more than half a minute. Two distinct forms of waves, one series from along the surface of the earth and another series from the depths or through the earth are superimposed. The structural engineer desires to know the amplitude and period of the earth movements, horizontally and vertically. He has little interest in these data for any shocks other than those of the greatest magnitude that may occur in the region where the proposed building is to stand.

The earthquake observatories and seismographs established in this and other countries during the past twenty or thirty years have been built and outfitted for the special purpose of accurately measuring and recording earthquake motions, and naturally the engineers turn to them for data, but meet with disappointments. Of course, no observatory can be expected to produce accurate measures for the amplitude and acceleration of a quake of greater violence than has ever yet occurred at its site; but on the other hand they appear poorly fitted out for measuring in any future severe earthquake precisely those characteristics which are of utmost importance to the engineer in these special problems of safeguarding life and economizing building material.

Almost every seismograph in use today is of a type so sensitive and so limited in its upper range of action that it will fail to register any quake of sufficient severity to interest the structural engineer.

About 20 years ago while on engineering studies for the water-works in the city of Mexico I spent half a day with the chief of the astronomical observatory examining his seismograph charts to find evidence of the amplitude and acceleration to be expected in a great quake. *In every case where the shock was severe enough to interest an engineer, the marker had gone off beyond the limits of the chart,* and the needed data could not be obtained.

Regarding the wonderfully sensitive new seismographs recently devised at Pasadena, one of the designers frankly said that quakes of above intensity VIII Rossi-Forel could not be recorded by these delicate instruments, and that they hoped later to devise an instrument that would record stronger motion. For the engineer's present purpose the many seismographs now scattered about the earth fail to give the data that the engineer needs. The accomplishment of seismograph designers and custodians up to the present time chiefly tends to aid problems of pure science, and mathematical geophysics. Moreover, nearly all seismographs are set on most carefully selected solid foundations on bedrock, and, for example, the beautiful instruments in the Pasadena Observatory on granite ledge would tell almost nothing about the character of the motion in a severe quake upon the deep, soft sediments of the Los Angeles river delta, on which scores of important buildings must be built which should withstand earthquakes.

Soon after the San Francisco earthquake in 1906, H. O. Wood, an expert student of geology and seismology, spent a long time studying its effect in different parts of the city, examining the wreckage of almost every building in a painstaking way. He found that the shock or injury was about five or ten times greater over areas of filled land or deep, soft and somewhat jelly-like sub-strata, than it was on nearby areas where foundations or buildings rested either directly upon ridges of rock or where there was only a thin stratum of relatively dry and firm earth between the bedrock and the building foundations. If, from the effect on buildings, one finds five-fold the apparent intensity of shock at one point that is found at another point less than half a mile distant, how great is the uncertainty of measuring the earthquake's vibration and amplitude at a given point by a seismograph five or more miles distant?

A cheap, rugged, simple seismograph is greatly needed to give data for structural engineers in designing safe buildings. These should be so cheap that one large city could maintain ten or more at selected localities, over different kinds of ground, set in basements of fire engine houses or larger municipal buildings and warehouses, so that they would record the same kind of shock that the building receives. Meanwhile, some should be set near the tops of tall buildings.

Their chief purpose is to give accurate measure of the amplitude and acceleration of the repeated shocks that are imposed upon buildings with foundations of various depths in mobile earth, as well as on rock, and subject to various inertia effects of the superincumbent mass.

Providence, R. I.
July 5, 1927.

JOHN R. FREEMAN,
Consulting Engineer.

Timing Concrete Mixes

Sir—In *Engineering News-Record* April 14, p. 623, an illustration of a batch meter made of two fruit jars appears. For use on several small concrete mixers not equipped with batch meters, in the construction of the Cushman hydro-electric plant completed last year for the light department of the city of Tacoma, Wash., a batch meter was made by H. S. Smallwood, testing engineer, of two old electric lamps by grinding off the bases to give open ends and putting the base ends together with a perforated disk between. The two lamps with sufficient screened fine sand were secured in a skeleton frame of light box lumber attached by a pivot to a piece of ¾-in. lumber about 6x12 in. long with a hole in the upper end for hanging in a convenient and conspicuous place. When all the materials for a batch were in the mixer the glass was turned over on the pivot. A counter, which was the only item of expense, mounted on the stationary board, and operated each time the glass was reversed by a piece of light flat steel spring attached to the pivoted frame, furnished a check on the batch tally.

Aberdeen, Wash.,
May 6, 1927.

R. F. BULLARD,
Designing Engineer,
Wynooche Project.

News of the Week

Current Events in the Civil Engineering and Contracting Fields

Moffat Tunnel Holed Through on July 7

The main railroad headings of the Moffat Tunnel, in Colorado, were holed through on July 7, leaving only 2,700 ft. of bench (about 10x16 ft.) to be excavated before the tunnel will be ready for the first train to pass through. Practically all of the completed tunnel is ballasted, and 1,900 ft. of the widenings above the bench have been excavated and timbered. Much of this remaining portion of the tunnel is in very heavy, ground, and some of it will require steel lining as well as concrete.

No predictions are made as to the date of completion, because of the uncertainties in the remaining soft ground, but the work is being attacked at fifteen different places, at various cross-cuts. The contract time expires July 20, which means that there will be no bonus for the contractors. However, the east half was finished last December, showing that only the very soft material at the west end interfered with the former rapid progress which would have resulted in a large bonus. The pioneer or water tunnel was holed through Feb. 18 and is completed. The progress on the main or railroad tunnel up to July 1, is given below. There was then 67 ft. of heading to be driven and 2,872 ft. to be enlarged to full section.

	From East Portal Ft.	From West Portal Ft.	Total Ft.	Per Cent Finished
Pioneer tunnel	...	...	...	100.0
Main headings	18,402	13,784	32,186	99.8
Full section	16,828	12,553	29,381	91.1

European Capitals Suffer From Cloudburst Rains

Rains of a cloudburst intensity were recorded at various European centers on July 11, according to press cables. London suffered when "two converging thunderstorms, one from the southeast and the other from the southwest" hit the city. Low lying parts of the city were flooded suddenly.

The boulevards of Paris were inundated and traffic was disorganized by a downpour which, the press reports, flooded some streets and squares until they assumed the aspect of lakes. Collapses of embankment and scaffolding, where building operations were under way, were reported.

In Berlin the Berliner Strasse was inundated in places to a depth of 2 ft. The worst storm of the week was reported from Saxony last week, where a cloudburst resulted in the death of some two hundred persons and in property damage of over 50,000,000 marks.

Am. Soc. C. E. Board Meets At Denver

Well Attended Sessions Precede Annual Convention—Licensing and Ethics Considered

(*Engineering News-Record Staff Report*)

THE meeting of the Board of Direction of the American Society of Civil Engineers at Denver, Colo., July 11 and 12, preceding the annual convention of the society, was well attended, 21 out of 25 directors being present. A resolution was passed authorizing cooperation with the other founder societies by appointing three members to a joint committee to consider the possibility of joint action in the interest of bringing about adequate appreciation of the engineer in the community.

Applications for student chapters at Columbia University and the University of South Carolina were approved. Feeling that the form of act heretofore recommended by the society for registration of professional engineers was deficient in two particulars the board recommended incorporating in the act two paragraphs: one having to do with the renewal of applications, and the other having to do with reciprocity between the states and Canadian provinces. The board received the report of its committee appointed at the Asheville meeting to survey the joint activities of the society with other societies and the organization and operation of the joint agencies engaged in such work. The board approved the recommendations of the committee looking to the simplification of such activities by the founder societies.

A committee appointed to outline a program for research into the engineering problems and the behavior of soils consists of Col. Charles R. Gow, of Boston; Arthur N. Talbot, University of Illinois; and Allen Hazen, of New York. H. J. Burt, of Chicago, was appointed one of the society's representatives on the Washington Award to succeed Francis C. Shenehon, consulting engineer of Minneapolis, whose term had expired. The board also appointed Arthur Surveyer as the society's delegate to the centenary celebration of the University of Toronto in October.

The board devoted considerable time to the consideration of more than 200 applications for membership. Applications in hand to date are 62 per cent in excess of those received in a like period last year.

The committee on Professional Conduct reported on three cases involving professional ethics. One of these, looking toward expulsion, was dismissed as being without sufficient evidence to justify such action. In the second case steps were taken toward disciplinary action. The third case involved the query as to the propriety of certain acts on the part of a consulting engineer in the promotion of his practice.

Great Northern Pacific Railway Applies for Consolidation

Plans for the consolidation of the Great Northern, the Northern Pacific, and Spokane, Portland & Seattle Rys. into a new railway to be known as the Great Northern Pacific, have been formally presented to the Interstate Commerce Commission. The new company has asked the commission to authorize it to issue stock and to control through lease and stock ownership the Northern Pacific Railway Co. and the Great Northern Railway Co. Also to acquire control by lease of the Spokane, Portland & Seattle Ry. The N.P. and G.N. own all the outstanding stock and bonds of the S., P. & S., and own 97 per cent of the stock of the Chicago, Burlington & Quincy Ry. The Burlington would continue to be operated as a separate company. The mileage of the Great Northern Pacific would be 15,750, which, with the mileage of the C., B. & Q., gives a total of over 25,000 miles.

Wanaque Aqueduct Controversy at Temporary Halt

A conference on July 7 of representatives of the contracting municipalities, held to discuss possible legal action against the North Jersey District Water Supply Commission in view of the failure of that body to join with the municipalities in the choice of an engineer-umpire on the conflicting engineering reports made to the commission, resulted in no decisive action. Apparently the controversy will be halted until the submission of the report of F. Herbert Snow, who was engaged by the commission in the face of protests by a number of the contracting municipalities.

Large Water Power Projects Get Federal Approval

A license covering the large water power development on the Saluda River in South Carolina which was described briefly in *Engineering News-Record* of Mar. 17, p. 464, was authorized at a meeting of the Federal Power Commission held July 8. This action was taken after the submission of a report by the Chief of Engineers, U. S. Army, finding that the project would affect the interests of commerce and recommending that the commission take jurisdiction. The license is to be issued to the Lexington Water Power Co. of Columbus, S. C.

which expects to install four 32,500 kw. units at Drehers Shoals. Provision is to be made for the installation later of two additional units. Exact details of the type of structure to be used are not yet available. Bids for the work have been received but as yet no contract has been let, although numerous reports to that effect have been published.

The commission authorized a license for the Shawano project of the Wisconsin Power and Light Co. on the Wolf River. A part of the reservoir which will be created is within the boundaries of the Menominee Indian Reservation, although the dam itself is outside the reservation.

This license covers the same project for which a license was issued last February. That license was rescinded at the request of the power company so that the state license might antedate the rights granted by the federal government. The Wisconsin authorities feel that a state license issued after the federal license would recognize the 50-year recapture provision of the Water Power Act. Wisconsin law provides for recapture after thirty years. Since rescinding the license the state has issued its permit and the commission again has authorized a federal license.

The commission declined to take jurisdiction over a proposed development by the Syndicate Power Co. of Dallas on the Colorado River of Texas, near Kingsland in Llano County.

A letter from Senator Howell of Nebraska asking that no action be taken on the application of the Potomac River Corporation for the development of power at Great Falls until after Congress meets was made a part of the record of the meeting. Senator Howell also filed a similar request in connection with the application of the Rocky Mountain Power Co. for rights on Flathead Lake.

Changes in Staff of New Jersey Health Department

Accompanying the appointment of a new director of the New Jersey State Department of Health on July 5, the water and sewage laboratories of the department were placed in the bureau of engineering. At the same time it was voted that the head of that bureau, while retaining his title of bureau chief, should be designated chief engineer of the department, and instructed to report to the members of the board—instead of to the director of the department as formerly. H. P. Croft remains as chief of the bureau of engineering, with the additional title already given.

D. C. Bowen, for many years chief of the bureau of local health administration and more recently state epidemiologist, is the new director of the department, succeeding Dr. H. B. Costill, who was appointed nearly four years ago to fill the unexpired term of Jacob C. Price. Clyde Potts, a resident of Morristown and a consulting engineer of New York City, was re-elected as president of the board.

Steel Building Frame Is Blown Down at Paducah, Ky.

An unusual accident in steel-frame building construction was the collapse of the steel frame for a six-story building at Paducah, Ky., during a high wind in the early morning of June 3. The building was to be a family hotel in the residence district. Local reports state that its frame had been completed to the roof. On the other hand, it is stated authoritatively that the structure was only about 33 per cent erected, which seems to indicate that some parts of the framing were omitted temporarily. The concrete floors had not been placed.

According to report there was considerable trouble and delay in getting the riveting equipment installed, but the erectors went ahead and put the frame together with service bolting, including the attachment of the columns to their anchorage angles. It is stated further that riveting began on the day before the accident, but continued only for about two hours. The frame was guyed by cables in the usual way, for adjustment in advance of the riveting, but this support was insufficient to hold the skeleton frame against a strong wind, which is said to have been almost a tornado. Long spans in the top floors are reported as reducing the amount of framing and the number of connections.

The basement is of reinforced-concrete, carrying the first floor, which is of concrete slab and joist construction, with tile fillers between the joists. Anchor bolts in the concrete column held steel base slabs and pairs of angles between which the steel columns were seated and bolted.

A sudden and sharp wind storm blew across the city about 4 a. m. and the six-story skeleton collapsed. Fortunately the wreckage fell into a street and the only damage done was to a gasoline filling station. The accident occurred so early that no people were about, and as there were no casualties there was no official investigation. The wreckage was cut apart with torches and removed rapidly, a considerable portion being salvaged and returned to the shops for straightening or repair.

The building was being erected for the Charleston Investment Co., and the architects are given as Menske & Bartling. William H. Cunliff was the general contractor, and the Atlas Iron Works fabricated and erected the steel under sub-contract. All these firms are of St. Louis, Mo.

Mississippi River Commission to Rebuild Gaps in Levees

Gaps in the Mississippi River levee line are to be closed with all possible speed. Legal interpretations of the flood control act will not be allowed to interfere with the prosecution of emergency work, it was stated recently at the War Department following a conference between General Jadwin, Chief of Engineers and Colonel Potter, chair- of the Mississippi River Commission. The Judge Advocate General is now wrestling with the problem of finding some way whereby local contributions may remain unpaid until Congress will have had an opportunity to relieve the local interests of that legal obligation.

One of the problems which must be worked out in this connection is some way to be entirely fair to the levee boards which have been paying their part of levee construction through the years. At a number of points in the lower valley the local interests have opposed coming under the jurisdiction of the Mississippi River Commission because they did not want to contribute one-third of the cost of levees such as the commission builds. These particular localities have been willing to rely upon small levees, the total cost of which has been less than the amount which would have to be contributed were standard levees constructed. These localities now are clamoring for the reconstruction of those inadequate levees with flood control money. It is held that this would not be fair to the levee boards that have co-operated with the commission.

Montreal Typhoid Cases Down to Seven A Day

A marked decline in the number of typhoid cases reported at Montreal has taken place recently. For the week ended July 7, the eighteenth week of the epidemic, there were 46 cases recorded, or 6½ a day, compared with 72, 92 and 92 cases in the successively preceding weeks and 727 cases for the highest week of the epidemic, ended May 19. For the five days ended Tuesday, July 12, the cases totaled 36, or an average of 7 a day.

A report made by representatives of the U. S. Public Health Service sent to Montreal with the consent of the various Canadian authorities, after surveying the cause of the epidemic up to June 28 and weighing the evidence as to causes, confirms the conclusions of the local and provincial health authorities that the epidemic was caused by infected milk, credits the local health department with doing all it could with its limited staff and funds, and expresses the belief that the local department is still handicapped, the milk supply still inadequately guarded, and Montreal not yet (June 28) a safe place for people subject to typhoid infection.

In a press dispatch prompted by the report just summarized, Dr. Alphonse Lessard, director, provincial bureau of health, stated (July 7) that the epidemic was under full control; that the cases being currently reported are secondary or contact cases; and that for "a long time there had been no primary cases" —a question considered editorially on page 47 of this issue, in a discussion written before Dr. Lessard's statements had been seen.

Details of the Public Health Service report will be given in a later issue.

Carolina Engineers Consider Code and Minimum Fees

At the tenth annual convention of the North Carolina Society of Engineers held recently in Wilmington, the proposal for adoption by the organization of a code of practice and schedule of minimum fees was discussed at length. It was announced that copies of the code and schedule of fees will be forwarded to all engineers in the state for their consideration. Final action on the code will be taken at the convention to be held in Raleigh in January. The report of the code committee was submitted by C. A. Mees, of Charlotte, who said something must be done to create a movement for selling engineering service to the public. He also said that through the proposal it is believed it will be possible to eliminate "under bidding" on engineering contracts and remove the obstacle under which the engineers are struggling, that is being fought by their clients immediately after the question of fees has been approached. His plan involves the setting of a minimum scale and the selling of engineering service instead of simply taking a job for the money involved. Under this plan, he continued, the engineers will be able to show their worth to their clients and will thus establish public confidence generally in engineers.

C. E. Waddell appealed for adoption of the schedule of fees, making it possible for the engineers to obtain fair compensation and to be in a position to assure employment to their assistants.

The closing session included the following subjects: "The Relation of the Engineer to the Public through the Medium of a Public Service Corporation," Raymond Hunt, vice-president of the Tide Water Power Co.; "What the Profession of Engineering Has Done for North Carolina," J. L. Ludlow, consulting engineer, and "The Workings of a Modern System of Communication," by J. A. Hebert, division plant engineer of the Southern Bell Telephone Co.

The meeting place of the 1928 convention will be determined at a session of the board of directors to be held later in the year. Officers will be elected at the meeting in Raleigh in January.

Drainage Commission Personnel

In *Engineering News-Record*, June 23, p. 1038, there was given under brief news the personnel of the Metropolitan Drainage Commission for the St. Paul and Minneapolis districts. The members of the commission were therein incorrectly stated. The complete commission is as follows: Russell M. Bennett, appointed by the mayor of Minneapolis; C. F. Keyes, appointed by the Minneapolis City Council; Oscar Claussen, appointed by the mayor of St. Paul; George M. Shepard, appointed by the St. Paul City Council; and Clarence Terse, appointed by the governor. This commission is appointed to study the subject of sewage disposal and treatment for the metropolitan district.

Engineering Educators Hold Annual Meeting

Attendance Largest in History—Report of Board of Investigation and Co-ordination Presented

(Special Correspondence)

The Society for the Promotion of Engineering Education held its 35th annual meeting at the University of Maine, Orono, Maine, June 27-30, with an attendance of 440 and with 39 states, Canada and Mexico represented. This attendance is the largest the society has ever had, surpassing that at the Boulder meeting of two years ago by about 70. Local committees, functioning under the direction of Dean Paul Cloke, laid the groundwork for a most successful convention. The social features were well arranged. The meetings were held in a central auditorium, with one exception, an afternoon meeting at which Director Wickenden presented his report. That gathering was held in the oval with the speakers standing on a rustic stage. Among entertainment features were a trip to Lucerne-in-Maine, visits to the Old Town Canoe Co., and trips to Moosehead Lake and Bar Harbor.

The formal programs were full. The number and scope of the papers were such that time limits had to be imposed on discussion. Several special meetings were held for the different sections and committees. Notable among these was a joint meeting of the division of deans and administrative officers and teachers of English. The subject for that meeting was "The Teacher of English in the College of Engineering," and the discussion, under the direction of Prof. J. Raleigh Nelson, of Michigan. Points were made such as to refute the often-expressed opinion that teachers of English to professional groups have no future. There is a real field and it is the experience of many of the departments that the ablest of English teachers can find interest and opportunity to serve in the teaching of engineering English.

At the first regular session President Boardman of Maine, formerly dean of engineering, made the address of welcome. A paper by Professor Comstock on "Modern Educational Tendencies as Affecting the Preparation of Engineering Students" aroused a good amount of live discussion.

One of the more important features of the business of the convention was the presentation of the report of the Board of Investigation and Co-ordination. Chairman Scott of Yale reviewed the work of the Board and spoke of some of the future plans.

The proposed program calls for two more years. During that time will be consummated the rounding up of the report, the maintaining of close relationships with the schools, summer schools for improving engineering teaching, study of co-operative education, the study of aids to vocational guidance, and various other points. He pointed out that one of the gratifying features of the work so far has been that engineering education is fundamentally sound and needs not so much revision as amplification and orientation. Educational needs have been inadequately met financially. One of the most important functions appears to be the co-ordination of the efforts of the scattered institutions.

Associate Director Hammond took occasion to call attention to the summer school for engineering teachers which is being held for the first time this summer. For this first trial session, mechanics, being considered a linking up of the fundamental mathematics to the technical engineering subjects, is being taught. The instructional staff for the summer schools is made up of older experienced men of special ability. The personnel of the conference is varied, ranging from younger instructors learning to teach to older experienced men coming for inspiration and new ideas.

In his formal paper, Professor Hammond reviewed engineering education through the past two or three decades. In making recommendations for the future he suggests the earlier completion of some of the more general fundamental courses such as mechanics, which will necessitate having entrance conditions fully satisfied and having some of the more elementary mathematics taken care of in the secondary schools.

The student's load in engineering colleges has rather generally been somewhat heavier than in arts work; the associate director belives this to be sound. Engineering is of itself arduous and exacting. Students of it are not unduly burdened and to be fully prepared must be taught rigorously. The fault, if any, lies in division of attention.

Director Wickenden dwelt upon the

Panama Canal Society Plans to Revisit Old Scenes

At a meeting Friday, June 10, of the directors and officers of the New York chapter of the Society of the Panama Canal, a society composed of the men who built the Panama Canal; preside over by Ralph Budd, a former canal employee and now president of the Great Northern Ry. Co., tentative arrangements were made for an excursion of old construction employees and their immediate families to the Canal about Jan. 10, 1928.

Six days will be consumed by the "ditch diggers" on the Canal Zone in seeing the sites of their old "jobs." The balance of the three weeks spent in going and coming, including two days at Port au Prince, will be consumed in renewing acquaintances and in reminiscing. Employee rates will probably be granted the old "ditch diggers."

General George W. Goethals, former governor, will lead the movement.

Secretary and treasurer of the Panama Canal Society, is W. H. Winters, Room 1440, 30 Church St., New York City.

academic origin of engineering training as opposed to the more practical and self-controlled development of medicine, law and dentistry, as professions. Engineering in general occupies the position of a broad functional group in society as opposed to the narrow self-constituted professional group which exists within the broader general class. There is no hope now for a strictly professional mold of educational practice in the secondary preparation for engineering work. It is better to avoid any attempt at close professional status because of the general nature of the engineering group. The profession can not be a leader if it narrows itself to a purely professional basis; it rather should hope to professionalize business and industry. After the extended concentrated study made by the Society's board the conclusion has been reached that engineering education would better be a unified process, that is, that it hardly seems practicable to attempt to give a pre-professional course for engineers such as is now employed in the training of medical or legal students. Nor does it seem feasible or desirable to have a longer engineering curriculum than the four-year one now ordinarily employed. In the discussion of Mr. Wickenden's report, several institutions which have tried the longer course were discussed by their representatives—Dean Hughes of Harvard, Professor Dudley of Yale, Dean Sackett of Penn State, and others.

The subject of graduate studies which was before the meeting of the deans and administrative officers was taken up in three formal papers by Professor Butler of Arizona, Professor Jackson of M.I.T. and Mr. Coler of the Westinghouse Electric and Manufacturing Co. In one of the papers it was recommended that only schools adequately manned and equipped both in laboratory and library give graduate work. This point was debated by representatives of some of the smaller institutions who pointed out that the possibility of giving graduate courses was necessary to the maintaining of proper faculty morale and student achievement.

Mr. Coler presented the viewpoints of industry in speaking of the collaboration of the University of Pittsburgh and the Westinghouse company. Professor Timbie of M.I.T. presented the plan followed in co-operative courses.

Professor Ayer discussed co-operative courses, looking particularly at the points mentioned in Bulletin No. 12 of the Investigation of Engineering Education. He pointed out that there were over 300 companies who strongly endorsed the plan and a very limited number against it.

The report of the treasurer was gratifying, an even larger favorable balance existing this year than last. The council announced several matters of importance. A standing committee was appointed on co-operative methods of teaching. The division of deans and administrative officers was merged into one new division entitled Institutional Members, with one of the vice-presidents delegated to act as chairman. A plan was formulated to provide a permanent central staff for research and correlated activities. To carry out such a program, it was decided to seek to obtain support, preferably in the form of a permanent endowment.

Officers for the coming year will be, R. L. Sackett, Pennsylvania State College, president; C. E. Magnusson, University of Washington, and T. E. French, of Ohio State University, vice-presidents; F. L. Bishop, University of Pittsburgh secretary; W. O. Wiley, New York City, treasurer: and J. M. Bryant, University of Texas, S. B. Earle, Clemson College, S. S. Edmands, Pratt Institute, H. P. Hammond, Polytechnic Institute of Brooklyn, A. C. Lanier, University of Missouri, C. M. McKergow, McGill University, and D. B. Prentice, Lafayette College, directors. The 1928 convention will be held at Ohio State University, Columbus, Ohio.

Brief News

THE THIRD INTERNATIONAL CONGRESS OF SCIENTIFIC MANAGEMENT will be held in Rome, Sept. 5 to 8, bringing together representatives from various nations, associations and institutions engaged in the study of scientific management in industry and agriculture. Former congresses were held in Brussels and Prague. Papers for discussion should be submitted to the secretary of the committee, Piazza Veneziall, Rome, before July 31. Visits to ancient and modern Rome, including the great industries of Turin and Milan and the hydro-electric plants in the Alps, are on the program.

AGITATION FOR A NEW EAST and west railroad across Oregon has been revived by the Public Service Commission of the state in a complaint to the Interstate Commerce Commission concerning the failure of the Central Pacific to construct a railroad line from Crane or Harriman, in the eastern part of the state, across to Crescent Lake or some other point on the Southern Pacific at the western side of the state. A similar complaint was made about two years ago, but the commission did not consider that the construction was necessary at that time. The only construction which the commission has authorized is that from Ben south to Klamath Falls, work which is expected to get under way in the near future.

ENGINEERS OF THE NEW ORLEANS LEVEE BOARD have completed their plans for closing the spillway made in the Mississippi levee at Caernarvon with a bulkhead of sheetpiling. It is expected that the work of building the bulkhead will be started about the middle of July and will take about 30 days. The estimated cost is placed at $150,000.

Washington Notes

PUBLISHED statements that a preliminary permit has been issued to the Potomac River Corporation and that the Federal Power Commission would hold a public hearing July 20 in connection with the proposed development at Great Falls, has caused some misunderstanding as to the status of the project.

The facts are that no permit has been issued and no hearing has been scheduled. The application has been referred to the district engineer in the usual course and it is probable that public hearings will be held in the course of his investigation.

In view of the fact that legislation providing for the development of Great Falls has made some progress in previous Congresses, it is assumed that the Federal Power Commission will make no disposition of the project until some further opportunity has been given Congress to act. The case has been complicated further by the opposition of the National Capital Park and Planning Commission which wants the gorge of the river preserved for park purposes.

SECRETARY WORK of the Interior Department has left Washington on a six-weeks' tour of reclamation projects and Indian reservations. He was accompanied as far as Denver by Dr. Elwood Mead, the Commissioner of Reclamation.

One of the purposes of the trip is to decide upon a policy in connection with the distribution of power from the plant at the Guernsey dam. The market for power is increasing rapidly in the vicinity of the plant. Power is sold at the switchboard. Present returns are in excess of $100,000 annually. The capacity of the plant is 3500 hp. An addition, however, is under construction and will be ready for service before the end of the year. This will make an additional 3500 hp. available. A transmission line is being built along the Platte River which will make the power available to other municipalities. The profits from sales of power will be sufficient to pay the greater part of the cost of the dam, thereby relieving the water users of that charge.

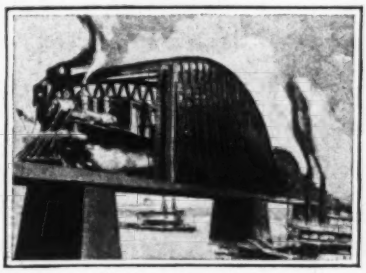
DR. ELWOOD MEAD, the Commissioner of Reclamation, has been granted a two-months' leave of absence to enable him to make an examination of the irrigated lands of American Zionists in Palestine. He will sail July 31. Several years ago Dr. Mead served as adviser to the British Zionists and assisted them in the formulation of their reclamation projects.

ALL of the appendices of the St. Lawrence report of the Joint Board of American and Canadian Engineers with one exception were approved at the meeting in Ottawa last week. Another session at which that appendix will be considered further is scheduled to be held in Detroit July 14.

Random Lines

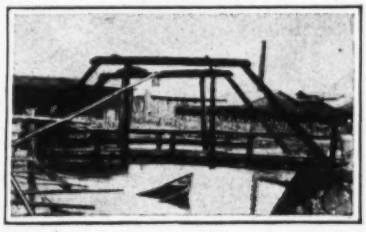
Art vs. Practice

Dear Sir: Attached is an addition to your gallery of super-engineering feats. The bridge truss apparently shrank and the steamboat stacks are doubtlessly of



the collapsible type. The pathetic part is that this picture formed a part of an advertisement setting forth the accomplishments of an engineer—John Deere. D. G. W.

From far Japan, via S. Nagao, of Jakamatsu, comes this reproduction in the wood of some of the bridge trusses



our advertising friends have been using, as noted in this column.

* * *

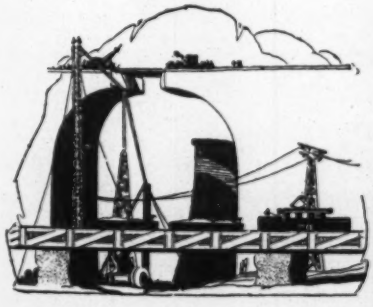
Degrees vs. Per Cent

"Whippet climbs Mill Mountain, Roanoke, Va., 'in high.' Entire grade not less than 4.5 *degrees* at any spot and in many places 11 *degrees.*"—Overland automobile advertisement.

"The wreck occurred on a twelve *per cent* curve, one of the many such which remain on the Denver as a legacy from the improvident Gould régime."—Boston *Transcript.*

* * *

What Isn't Wrong With This Picture



Personal Notes

VANCE P. EDWARDS, of the U. S. Forest Products Laboratory at Madison, Wis., has resigned to become mill manager for the Northwestern Pulp & Paper Co. at Astoria, Ore.

T. P. CLONTZ, of Muskogee, and Roy Flood, of Sapulpa, have been named as district engineers of the Oklahoma State Highway Department. Mr. Clontz will have headquarters at Muskogee and Mr. Flood at Tulsa. The former succeeds J. H. Tait and Mr. Flood T. W. Bailey.

MAJOR C. P. GROSS, Corps of Engineers, U.S.A., has taken over the duties of district engineer at Los Angeles, succeeding Major H. A. Finch who has filled this office for three years and is now ordered to the U. S. Engineering School at Fort Humphreys, Va.

FRANK MANNING, resident engineer on the improvement work of the Pere Marquette R.R., at Flint, Mich., has been appointed assistant division engineer at Grand Rapids, Mich.

E. B. BUMSTED, formerly with the Hammon Engineering Co., San Francisco, has resigned to become assistant to the vice-president and consulting engineer of Hunter, Dulin & Co., investment bankers, San Francisco.

DR. J. E. CHURCH, JR., director of the Nevada State Co-operative Snow Surveys, at Mount Rose Observatory, Reno, Nev., has gone to Greenland to study snow and meteorological conditions. This is his second trip and he will remain until the summer of 1928.

S. F. GREAR, office engineer of the Illinois Central R.R., has been appointed assistant engineer of bridges, with headquarters at Chicago. He succeeds Charles Chandler, who resigned recently to go with the J. G. Brill Co., at Philadelphia, Pa.

R. K. ROCHESTER, general superintendent of the New Jersey Division of the Pennsylvania R.R., has been appointed assistant general manager of the Eastern Region of the Pennsylvania System, with headquarters at New York. Mr. Rochester is an engineer, a graduate of Rose Polytechnic Institute, who began work with the Pennsylvania System in 1901, remaining in the engineering department until he was promoted to be superintendent of the Peoria Division of the Vandalia. During the World War he spent a year in the service.

RAYMOND SWENK, engineer, maintenance-of-way, Southern Division of the Pennsylvania System, has been promoted to the position of superintendent of the Erie and Ashtabula Division, with headquarters at New Castle, Pa. He has been succeeded in the maintenance-of-way work by J. H. Cooper, division engineer of the Philadelphia terminal. F. M. Hawthorne, division engineer of the Cleveland and Pittsburgh Division, succeeds Mr. Cooper, and H. T. Frushour Mr. Hawthorne.

CHARLES J. DESBAILLETS, chief engineer of the Montreal Water Board's new pumping station at St. Joseph St., Verdun, Quebec, has been appointed manager of the city of Three Rivers, Que., for a period of four years. Mr. Desbaillets has done important work in connection with the planning and with construction work in the extension of the water system of Montreal.

Engineering Societies

Calendar

Annual Meetings

ASPHALT PAVING CONFERENCE: Under the auspices of the Asphalt Association and Association of Asphalt Paving Technologists; annual conference Atlanta, Ga., Nov. 28-Dec. 2, 1927.

THE ROADMASTERS & MAINTENANCE-OF-WAY ASSOCIATION has announced the following subjects for its annual meeting at Buffalo in September: (1) Arrangement of track work to provide for uniform forces throughout the year; (2) Collection and use of cost data on track work; (3) Education of track men to prevent accidents; (4) Reduction of stock of material in the track department; (5) Means of reducing work-train service. T. F. Donahoe, B. & O. R.R., Pittsburgh, Pa., is secretary of the association.

Obituary

JACOB P. HOLLER, of the J. P. Holler Construction Co., Fort Edward, N. Y., died at Ticonderoga, N. Y., July 7, aged 63 years. Mr. Holler spent his life on contracting work and handled many barge canal and road contracts. At the time of his death he was engaged upon the Ticonderoga-Crown Point state highway resurfacing job. From 1919 to 1923 Mr. Holler was associated with Dwight B. LaDu under the firm name of Holler & LaDu but when Mr. LaDu became state engineer of New York Mr. Holler formed the company bearing his name only.

WILLIAM P. GERHARD, Scarsdale, N. Y., retired consulting sanitary engineer, died July 8 at his home in Scarsdale, aged 72 years. Mr. Gerhard was born in Hamburg, Germany, and graduated in 1875 at the Polytechnic School at Karlsruhe, and shortly thereafter came to America. He wrote many articles and books relative to sanitary engineering work. At one time he was editor of *Building.*

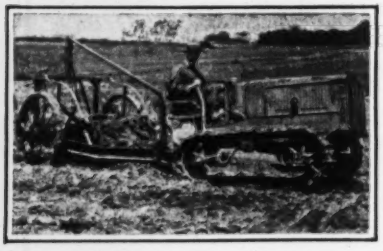
Construction Equipment and Materials

A Section Devoted to What the Manufacturer Is Doing for the Engineer and Contractor

One-Man Wheeled Scraper for Caterpillar Tractor

A new model of its one-man power scraper has just been announced by the Miami Trailer-Scraper Co., Troy, Ohio, designed for operation with a 2-ton Caterpillar tractor. It is of full ¾-yard capacity whereas a similar type heretofore manufactured for Fordson tractor operation had a capacity of slightly over 15 cu.ft. The accompanying illustration shows the new scraper in operation on a golf course.

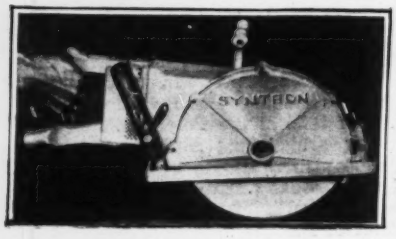
The unit is operated by the tractor driver and loads, transports and dumps



automatically. It will pick up its load ascending or descending grades as well as on the level and can be dumped on grades, moving forward, backward or when standing still. The pan is controlled through a winch which is claimed to have ample power to raise the pan out of the ground under the most adverse conditions. The unit is equipped with roller bearing wheels and one important advantage claimed for it is the ease with which it can be manoeuvred into difficult loading and dumping positions. The company also has under development similar units for attachment to the 10-20 McCormick-Deering tractor and the Model K Cletrac tractor.

Safety Guard a Feature of New Electric Hand Saw

The portable electric hand saw recently developed by the Syntron Company, Pittsburgh, Pa., is equipped with what is said to be a 99 per cent safety guard. This guard is of telescopic construction and swings back exposing the blade as the cut progresses. When the saw is removed from the cut, the guard instantly covers the spinning blade. Another feature of the saw is the large shoe which prevents the saw blade from weaving and holds the blade true to line without wrist strain. The shoe is adjustable to any depth cut from ⅛ to 4 in.



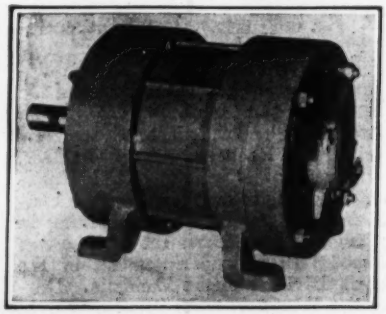
The motor operates on 110 volt either a.c. or d.c., although 220 volt current also can be used. The saw is fully equipped with Timken roller bearings. The blade runs at a speed of 1800 r.p.m. with normal full load, and special blades for mitering and for cutting special materials are provided. The dimensions of the saw are as follows: Length 22 in., height 12 in., width 7 in., diameter of blade 11 in. The saw weighs 31 lbs.

Power Pump Diaphragm Designed For Hard Service

A new diaphragm, style DP, has recently been developed by the Edson Manufacturing Corp., Boston, especially to withstand the increased strains and friction imposed by power-operated pumps. Change in design over the old diaphragm consists in the use of reverse curves which straighten out on the upward and downward stroke of the pump. This is claimed to eliminate the friction and kinking of the old style diaphragm. Service tests are claimed to have demonstrated the efficiency of this type of diaphragm, both in open discharge and in force pumps.

Ball Bearing Induction Motors Made of Welded Steel

A complete line of all-steel ball bearing poly-phase induction motors ranging in size from 1 to 100 hp. in all standard

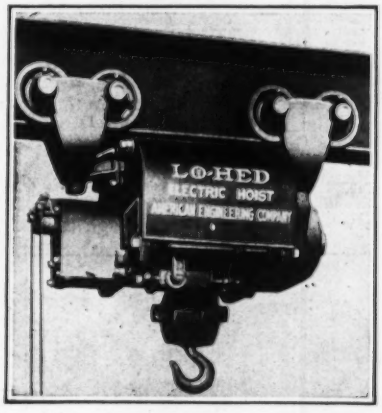


voltages and cycles is announced by the Lincoln Electric Co., Cleveland, Ohio. This type of motor is representative of the new designs of equipment being brought out by the Lincoln Electric Co., in which gray iron and malleable casting have been entirely replaced by rolled steel. It is claimed that every part of the new motor is at least twice as strong as the former type which was built with a cast iron frame.

Economies in manufacturing by the new process are claimed to have permitted the use of much larger shafts and bearings than are usually found on this type of equipment. Less thickness of metal is, of course, required in the frame and it is claimed that the increased ventilation so obtained results in a considerable increase in the overload capacity of the motor.

Electric Trolley Hoist Mounted on Eight-Wheel Carriage

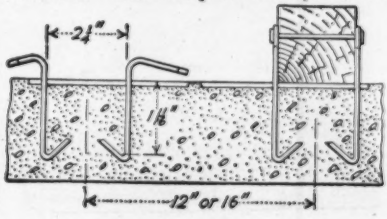
A new hoist built in half-ton and ton sizes, and similar in construction to the company's Class A Lo-Hed hoist, has recently been announced by the American Engineering Co., Philadelphia. The new hoist differs from the older



models in the fact that it is mounted on an eight-wheel carriage and reduces the head room requirement by some 5 in., the total head room necessary being 15½ in. The hoist will operate with a.c. at 20 ft. per min., or d.c. at 20 to 40 ft. per min. A special high-speed hoist is available for operation at 40 ft. per min. on a.c., and 40 to 80 ft. per min. on d.c. Standard height of lift is 20 ft. The ball bearing motor is designed especially for hoist service and holding and lowering brakes give full control of the hoist at all times, a positive acting upper limit device adding to the safety of operation.

Sleeper-Spacing Anchors Held Accurately in Position

A new sleeper anchor somewhat different from the usual anchor, in that it is welded along a longitudinal wire, has recently been placed on the market by the Union Steel Products Co., Albion, Mich., for use in reinforced construction. The sleepers are spaced at

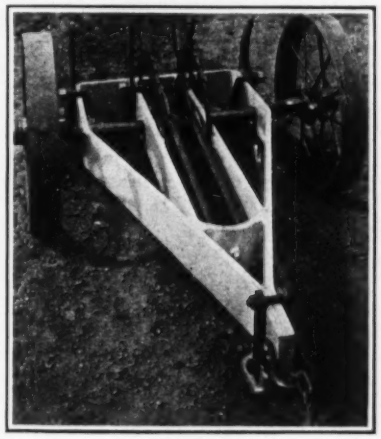


the usual 12 or 16-in. centers. The anchor strips are made of heavy wire 4 ft. long with five anchors on them when spaced 12 in. apart, and four anchors on them when spaced 16 in. apart. The upper part of the anchor that fastens to the sleeper lies close to the floor so that it is out of the way until the sleepers are ready to be placed. Then a claw hammer is sufficient to raise the ends of the anchor on both sides of the sleeper, when nails can be driven through the eyes and through the sleeper, giving a direct anchorage to the concrete.

The anchors are shipped 250 ft. to the bundle, there being 250 anchors per bundle when spaced 12 in. on centers, and 200 anchors per bundle when spaced 16 in. on centers.

Rooter Plow Equipped With Wheels In Place of Plow Handles

A new road rooter plow is being placed on the market by Ted Carr & Co., Chicago, which can be used with one tooth as a single plow, or with two, three or four as a gang plow. Since a tool of this kind has to keep pace with modern tractors, the wheels have been equipped with Timken bearings. The teeth are held in place by a U bolt clamp which has been made amply large and



equipped with cold finished nuts to make easy the frequent loosening and tightening that is necessary to reset the teeth. The solid steel frame is arc welded, and the beam shoe is an unannealed casting.

New Publications

Diesel Engines—CHICAGO PNEUMATIC TOOL CO., New York, in its Bulletin 774 makes available for the first time a complete description of its new M.W.M. Benz Diesel engine, type RH 40. Line drawings, installation views and cost comparisons between fuel for oil, gas and steam engines and current for electric motors are included.

High Early Strength Concrete.—ALPHA PORTLAND CEMENT CO., Easton, Pa., has published two new bulletins concerning the use of its Alpha cement for high early strength concrete. The first of these bulletins discusses the use of the company's regular cement for high early strength and gives results of laboratory tests and a pavement test installation. The second pamphlet is written by H. Eltinge Breed and gives the engineering and technical details of the test pavement described in the first pamphlet.

National Reinforcing Manual—NATIONAL STEEL FABRIC CO., Pittsburgh, Pa., has compiled a loose leaf data book designed to cover every phase of plastic material construction where welded steel fabric may be used. Besides giving tables and instructions for the use of steel mesh reinforcement, the handbook considers such fundamentals as mechanics of materials and the properties of concrete, the manufacture of steel and the designs, theories and practice for reinforced concrete construction. A price of $2 is listed for the manual, and inquiries should be written on company letterhead, with title.

Silica Admixture for Concrete—CELITE PRODUCTS CO., Los Angeles, has published a new 15-page booklet on the use of Celite in concrete which explains the use of its special grade of diatomaceous silica as used in concrete construction, showing its effect on the improvement of workability, which in turn contributes to uniformity, strength, water-tightness, permanence and appearance. A discussion is also given concerning the use of Celite where the water cement ratio is specified.

Material Elevators—LINK-BELT CO., Chicago, in its book No. 680, devotes 44 pages to illustrations, examples, ratings, capacities and tables showing how to select typical material elevators. The elevators described are divided into three classes: for handling coal and other non-abrasive materials which weigh approximately 50 lb. per cubic foot; for handling ashes and abrasive materials weighing about 40 lb. per cubic foot; and for handling either abrasive or non-abrasive materials weighing about 100 lb. per cubic foot. These are also divided into the two typical types of elevators in use, known as the centrifugal discharge and the continuous bucket types.

Seamless Steel Products—SEAMLESS STEEL EQUIPMENT CORP., New York City, describes in a new catalog its products for high pressure and temperature requirements, such as cumulators, air containers, boiler drums, gas vessels, gasoline cracking stills, hydraulic rams, shafts and high pressure tanks. These steel products are made by three processes—forging; pressed, drawn and rolled; or pressed and drawn.

Air Compressors—NATIONAL BRAKE & ELECTRIC CO., Milwaukee, Wis., has issued a new catalog, No. 907, in which is illustrated and described its latest development in air compressors. These new air compressors use a mechanically operated sleeve type of intake valve which is claimed to permit operation at higher speeds and to result in greater efficiency and unusual quietness. The bulletin gives complete information on the new design besides giving data and prices on the various models that are available.

Road Guard—CYCLONE FENCE CO., Waukegan, Ill., has had published a booklet containing a copy of a report on tests of its chain link road guard fabric made at the University of Illinois, largely to show the energy absorbing qualities of the fabric. This was found to be about 3,200 ft.lb. per foot of fabric as a maximum. Tables and illustrations are given in addition to load elongation curves.

Steel Cylinder Foundations—UNDERPINNING & FOUNDATION CO., New York City, has issued a bulletin describing and illustrating in detail its steel cylinder foundations and the methods of their construction. Illustrations are also given of a large number of buildings supported on this type of foundation.

Cutting and Welding Equipment—CARBO-OXYGEN CO., Pittsburgh, in its Catalog No. 8, describes all of its various types of equipment for carbo-oxygen and carbo-hydrogen cutting and welding work. Complete outfits as well as individual pieces and accessory equipment are illustrated and listed according to order numbers.

Portable Air Compressors—BUHL CO., Chicago, has issued a new bulletin No. 104-C describing its type C portable compressors. Illustrations and detail specification tables are included.

Inundation—BLAW-KNOX CO., Pittsburgh, has published an illustrated booklet covering the use of its inundation systems on large central mixing plants. Many illustrations and a number of layouts of such plants are given. The principles of inundation and the importance of water control are considered. Several pages of the catalog are also devoted to the new junior inundator and to inundation for road construction.

Manufacturers and Trade Associations

Calendar

Annual Meetings

NATIONAL HARDWOOD LUMBER ASSOCIATION, Chicago; Annual Convention, Chicago, Sept. 15-16.

AMERICAN PAINT & VARNISH MANUFACTURERS ASSOCIATION, Philadelphia; Annual Convention, Atlantic City, Oct. 24-25.

NATIONAL ASSOCIATION OF MANUFACTURERS; Annual meeting, Chattanooga, Tenn., October 25, 26 and 27.

Business Side of Construction

Facts and Events That Affect Cost and Volume

This Week's Contracts—With Comparisons

Minimum costs observed are: $15,000 for water-works and excavation, drainage, irrigation, levee, river and harbor projects; $25,000 for other public works; $40,000 for industrial and $150,000 for commercial, educational, institutional, religious and other buildings.

Week ended	Public Work	Private Work	Total Contracts
July 14, 1927.....	$26,873,000	$49,319,000	$76,192,000
July 7, 1927.....	25,467,000	23,985,000	49,452,000
July 15, 1926.....	24,293,000	49,353,000	73,646,000
Jan. 1 to date			
1927	656,470,000	984,153,000	1,640,623,000
1926	593,504,000	969,682,000	1,563,186,000

E.N.-R. Index Numbers On July 1, 1927

COST	VOLUME
203.68	297

The Index Numbers are published in detail and with charts in the first issue of each month. The Cost Index is given in full from 1903 through 1926, with a thorough explanation of its method of computation, and a graphic comparison with many other index numbers, in the 48-page pamphlet entitled Engineering News-Record Construction Costs.

Weekly Construction Market

	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Steel Products									
Structural shapes, 100 lb.....	$3.34	$3.80	$4.00	$3.10	$3.35	$3.87½	$3.10	$3.00	$4.00
Structural rivets, 100 lb.....	5.00	3.80	4.75	3.50	3.75	4.65	5.00	5.00	5.50
Reinforcing bars, ¾ in. up, 100 lb..	3.24	2.80	2.75	2.30@2.50	2.87½	3.77½	2.95	3.00	3.57
Steel pipe, black, 2½ to 6 in. lap, discount.....	48%	54%	54%	51%	48%	41%	42@53.8%	48%	37.83
Cast-iron pipe, 6 in. and over, ton	—46.60	—40.00	54.00	44.20	46.50	56.50	49.00	55.00	55.00
Concreting Material									
Cement without bags, bbl.....	2.35@2.50	2.40	2.05	2.05	2.22	2.85	2.51	2.65	2.22
Gravel, ¾ in., cu.yd.....	1.75	2.20	2.38	2.00	1.65	1.90	1.80	1.25	1.90
Sand, cu.yd.....	1.00	1.40	2.00	2.00	1.25	1.00	1.40	1.25	1.35
Crushed stone, ¾ in., cu.yd.....	1.94	2.50	2.83	2.00	1.75	2.50	1.70	3.00	2.00
Miscellaneous									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.....	59@61	34.00	56.00	40.50	39.25	34.25	27.00	23.00	55.00
Lime, finishing, hydrated, ton.....	18.20	24.50	19.00	20.00	25.50	24.00	27.50	24.00	21.00
Lime, common, lump, per bbl.....	2.10@3.00	1.35	1.82	1.50	1.70	2.70	1.70	2.80	10.00
Common brick, delivered, 1,000....	17@19	12.50	—13.60	12.00	13.75	9@10	14.00	14.00	20.25
Hollow building tile, 4x12x12, per block.....	Not used	.0724	.103	.076	.072	.085	.....	.10	.10
Hollow partition tile 4x12x12, per block.....	.1027	.0724	.103	.076	.072	.085	.108	.09	.08
Linseed oil, raw, 5 bbl. lots, per 7½-lb. gal.....	—.87	—.90½	1.10	—.86	.96	1.10	.95	.95	1.03
Common Labor									
Common labor, union, hour.....	.90½	.30	.....	96	.....	.....	.60	62½	.....
Common labor, non-union, hour...	.....	.25	30@.50	....	45@.60	.31¼@.50	.50	.62½	.30@.35

Prices of Oil Field Materials and Equipment

Changes Compared with Year Ago Are Mostly Declines—Well and Refinery Products Firmer

AT A TIME when the daily rate of crude oil output is approximately 20 per cent above that of a year ago and yet steel pipe mill operations are down to 65 per cent of capacity owing to lack of further extension in oil country buying, the following current prices of oil field materials and equipment are drawn up, as indicating levels from which immediate recessions are improbable.

The price situation in products of the well and refinery shed some light on the probable trend of costs covering construction and operating equipment of these plants.

Crude petroleum quotations average 33 per cent under those of a year ago, while gasoline at refinery shows a decrease of 36 per cent in the same time. Service station prices of gasoline, however, are not more than 20 per cent below those prevailing at this time in 1926.

While kerosene prices lack strength, a more favorable outlook for the whole line-up is evident in the fact that crude oil quotations have remained unchanged for at least two months. In addition to this, gasoline, which remained firm for a short time recently, has now shown definitely upward tendencies in five out of six instances, on a tank wagon basis. Fuel oils have developed few price changes of late, while lubricants appear firmer.

Steel structurals used in derrick construction are approximately 8 per cent under prices of a year ago. Beams, channels, angles, tees (3 to 15-in.) and plates, ¼-in. thick and heavier, sell now at $1.75@$1.85 per 100 lb., f. o. b. Pittsburgh mill, against $1.90@$2 at this time last year.

The movement in sheets has been uneven. Blue annealed are at least 4 per cent under price levels of July, 1926, while the drop in galvanized has not amounted to more than a fraction of one per cent. Prices on black sheets are practically the same as at this time last year.

Manila rope quotations at the principal centers supplying the oil fields, average 1½c. per lb. under July, 1926 levels.

Steel wire, plain, base, Pittsburgh mill, at $2.40 per 100

lb., shows but a slight drop from the $2.50 quotations of a year ago. The Chicago price is $2.45, against $2.55 per 100 lb. in July, 1926.

Copper wire is 1½ to 2c. per lb. above last year's prices at Cleveland and Chicago. The price at the former city was 16½, and in the latter, 16c. per lb., base, in July, 1926.

Cast-iron pipe, 6-in. and over, Class B, ranges about 13 per cent under the July, 1926 prices of $41@$42 per net ton, Birmingham.

Vitrified clay pipe at principal mill points stands 5 per cent above prices in effect at this time last year.

Hose quotations are down 8 per cent, in many cases, compared with year ago levels. Water, air and steam descriptions all show declines.

Packing (rubber, duck and flax) sells below the July, 1926 market in this material, with the possible exception of asbestos for valve stems and stuffing boxes.

Cotton waste at Chicago warehouses has not varied in a year; Cleveland prices dropped 2c. per lb. on white stock.

Lime price advances from year ago levels, are three to one, compared with declines.

Cement mills supplying oil country consumers hold to an average price of $1.86 per bbl., exclusive of the cost of bags, against $1.90 a year ago; a drop of 2 per cent.

Prices of five very important materials in this group, namely, wire rope, chain, wrought-steel pipe, rubber and leather belting, pipe and boiler covering, have not varied in more than twelve months. All told, at least three-quarters of the total changes in prices of oil field materials, are below those of a year ago, with the downward movement a very gradual process.

Materials and Equipment

STRUCTURAL STEEL—Following are base prices per 100 lb. in carload lots, f.o.b. mill, Pittsburgh and Birmingham, together with quotations in less-than-carload lots from warehouses at places named:

			Warehouse			
	Pittsburgh Mill	Birmingham	Dallas	St. Louis	Chicago	San Francisco
Beams, 3 to 15 in.	$1.75@1.85	$1.90@2.00	$4.00	$3.25	$3.10	$3.10
Channels, 3 to 15 in.	1.75@1.85	1.90@2.00	4.00	3.25	3.10	3.10
Angles, 3 to 16 in., ¼ in. thick	1.75@1.85	1.90@2.00	4.00	3.25	3.10	3.10
Tees, 3 in. and larger	1.75@1.85	1.90@2.00	4.00	3.35	3.10	3.10
Plates, ¼ in. thick and heavier	1.75@1.85	1.90@2.00	4.00	3.25	3.10	3.10

SHEETS—Quotations are per 100 lb. in various cities from warehouse, also the base quotations from mill:

	Pittsburgh Large Mill Lots	St. Louis	Chicago	San Francisco
Blue Annealed No. 10	$2.25	$3.60	$3.50	$3.85
Black No. 24	3.00	4.50	3.95	4.90
Galvanized No. 24	3.85	5.35	4.80	5.45

For galvanized corrugated sheets add 15c., all gages.

WIRE ROPE—Discounts from list price on regular grades of bright and galvanized are as follows:

	Eastern Territory New York and East of Missouri River
Plow steel round strand rope	35%
Special steel round strand rope	30%
Cast steel round strand rope	20%
Round strand iron and iron tiller	5%
Galvanized steel rigging and guy rope	7½%
Galvanized iron rigging and guy rope	+12½%

California, Oregon, Nevada and Washington: Discount 5 points less than discount for Eastern territory.

Wyoming, New Mexico and Colorado: Discount 5 points less than discount for Eastern territory.

Arizona: Discount 10 points less than discount for Eastern territory.

Montana, Idaho and Utah: Discount 10 points less than discount for Eastern territory.

North Dakota, Nebraska, Kansas, Oklahoma and Texas: Discount 5 points less than discount for Eastern territory.

MANILA ROPE—For rope smaller than ½-in. the price is ½ to 2c. extra; while for quantities amounting to less than 600 ft., there is an extra charge of 1c. The number of feet per pound for the various sizes is as follows: ½-in., 8 ft.; ⅝-in., 6; ¾-in., 4½; 1-in., 3½; 1¼-in., 2 ft. 10 in.; 1½-in., 2 ft. 4 in. Following are prices per pound for ½-in. and larger, in 1200-ft. coils:

Chicago	$0.23	New Orleans	$0.21
San Francisco	.22½	St. Louis	.23
Denver	.25@.26	Kansas City	.25
Dallas	.31		

STEEL WIRE—Plain, base, per 100 lb., Pittsburgh mill, $2.40; Chicago, $2.45.

COPPER WIRE—Base, cents per lb. at warehouse:
Cleveland, 18.00 Chicago, 18.00

CHAIN—Proof coil, f.o.b. cars, Chicago, shipment from warehouse stock, base per 100 lb., $7.10 for 1 in.

CAST-IRON PIPE—The following are prices per net ton for Class B and heavier f.o.b. in carload lots:

	Birmingham	Burlington, N. J.	Pittsburgh	Chicago	St. Louis	San Francisco
4 in.	$40.00	$48.00	$48.50	$48.20	$45.60	$53.00
6 in. and over	36.00	44.00	44.50	44.20	41.60	49.00

Gas pipe and Class "A," $4 per ton extra.

VITRIFIED CLAY PIPE—The following prices are in cents per foot for standard pipe in car load lots, f.o.b., except as otherwise stated:

Size, In.	Pittsburgh	St. Louis	Chicago	San Francisco	Dallas	Denver	New Orleans	Kansas City, Mo.
3	$0.072	.....	$0.088	$0.12	.....	$0.135*	.....	$0.15
5	.099	.....	.121	.18	$0.18	.18*	.....	.21
8	.162	$0.26	.198	.30	.325	.27	$0.205	.335
12	.3105	.468†	.405	.56	.612	.47	.40	.54†
24	1.035	1.872†	1.80	2.16	2.04	1.70	2.27	1.90†
36	4.6125	4.80†	5.00	.....	5.42	.....	3.50	3.80†

*4-in. and 6-in., respectively. †Double strength.

PIPE GASKETS—Prices per 100 in large quantities, shipped from Akron, O., freight paid to destination. For use with standard flanges.

Full Face Type				Ring Type			
I. D., In.	O. D., In.	⅛-In.	¼-In.	I. D., In.	O. D., In.	⅛-in.	¼-In.
1	4	$18.70	$29.30	1	2⅞	$19.14	$28.40
6	11	34.80	62.50	6	8½	22.70	37.70
12	19	104.80	204.40	12	16½	82.60	142.90
24	32	283.10	529.50	24	28½	227.50	420.80
30	38½	369.90	702.10	30	34½	303.10	555.50

Discount from above list approximately 40 per cent. For punching bolt holes list, ⅛-in. thick, $8.40 per 1,000 holes; ¼-in. thick, $11.60 per 1,000 holes.

GATE VALVES—Iron body, bronze mounted, double discs, parallel seats, inside screw, stationary stem, screwed end, prices f.o.b. Williamsport, Pa., as follows:

Suitable for working oil or gas pressure not exceeding 800 lb.—
3-in. $19.20 each 4-in. $28.00 each
Suitable for working oil or gas pressure not exceeding 1,000 lb.—
3-in. $24.00 each 4-in. $53.60 each

WROUGHT STEEL PIPE—The following discounts from list are to jobbers for carload lots at Pittsburgh mill:

BUTT WELD

In.	Black	Galv.
⅛ to 3	62%	50½%

BUTT WELD, EXTRA STRONG (Plain Ends)

In.	Black	Galv.
⅛ to 1¼	60%	49½%
1½ to 3	61%	50½%

LAP WELD

2	55%	43½%
2½ to 6	59%	47½%
7 and 8	56%	43½%
9 and 10	54%	41½%
11 and 12	53%	40½%

LAP WELD, EXTRA STRONG (Plain Ends)

2	53%	42½%
2½ to 4	57%	46½%
4½ to 6	56%	45½%
7 and 8	52%	39½%
9 and 10	45%	32½%
11 and 12	44%	31½%

WROUGHT-STEEL PIPE LIST

Size, Inches	List Price per Foot	Diameter in Inches—External	Diameter in Inches—Internal	Thickness, Inches
⅛	$0.17	1.315	1.049	.133
¼	.23	1.66	1.38	.14
⅜	.27½	1.9	1.61	.145
½	.37	2.375	2.067	.154
¾	.58½	2.875	2.469	.203
1	.76½	3.5	3.068	.216
1¼	92	4.0	3.548	.226
1½	1.09	4.5	4.026	.237
1¾	1.27	5.0	4.506	.247
2	1.48	5.563	5.047	.258
2½	1.92	6.625	6.065	.28
3	2.38	7.625	7.023	.301
3½	2.50	8.625	8.071	.277
3½	2.88	8.625	7.981	.322
4	3.45	9.625	8.941	.342
4½	3.20	10.750	10.192	.279
5	3.50	10.750	10.136	.307
5	4.12	10.750	10.020	.365
6	4.63	11.750	11.000	.375
7	4.50	12.750	12.090	.330
8	5.07	12.750	12.000	.375

Discounts on large O. D. pipe, carload lots to jobbers, applying on list following, are:

14 and 15-in.	49%	21 and 22-in.	45%
16-in.	48%	24-in.	42%
17 to 20-in.	47%	26 to 30-in.	33%

LARGE O. D. PIPE LIST

O. D., In.	Thickness, In.	Price per Ft.	O.D., In.	Thickness, In.	Price per Ft.
14	¼	$3.68	21	⅜	$6.91
15	¼	3.94	22	⅜	7.24
16	¼	4.21	24	⅜	9.47
17	¼	4.48	26	⅜	10.27
18	¼	4.74	28	⅜	12.88
20	¼	6.58	30	⅜	13.82

HOSE—Quotations at New York warehouses:

Fire Protection			50-Ft. Lengths
Underwriters' 2½-in., coupled, single jacket			(net) 68c. per ft.
Common, 2½-in., cotton-rubber lined		80c. per ft. list less	50%
Air—Best grade			
½-in., per ft.	3-ply $0.34		4 ply $0.42
Steam—Discounts from List			
First grade 40%	Second grade 40–5%		Third grade 50%

ROTARY DRILLERS' HOSE—Price per ft., net, in large quantity shipments from Akron, O., freight paid to destination:

2-in. $1.60 2½-in. $2.00 3-in. $2.25.

DRILLING EQUIPMENT—Following are estimates covering diamond core drill and equipment, f.o.b. cars, Michigan City, Ind.; core fittings, 2-in.; depth, 3,500 to 5,500 ft.:

Diamond drill with partial equipment $8,784.00

Included in the price quoted are the following equipment items:

(One each)

Core barrel, 20-in.	Set of diamond setting tools
Core barrel, 10-ft.	Setting block
Drill rod, 5-ft., with coupling	Pipe wrench, 24-in.
Safety clamp	Monkey wrench, 12-in.
Sheave with strap and hook for hoisting rods, 48-in.	Set of solid wrenches for engine, chuck, etc.
Tool chest	Top check
Bail and bolt for hanging sheave	(Other materials)
Lifting bail with clevis	Lag screws, 12 x ¾-in. (2)
Hoisting swivel with coupling	Swivel unions for steam piping (3)
Water swivel with coupling and elbow, ball bearing	Rubber and hemp packing
Machinist's hammer	Waste
Screw driver	Pipe and fittings for connecting drill, pump and boiler
Draw bolt for gear	Water hose, 25-ft., 1-in., 5-ply, with connection for drill and rods
Level, 6-in.	Water hose, 12-ft., 1-in., 5-ply, with connection for drill and boiler
Oil can, 1-gal.	Drip hose, 5-ft., ¾-in., 4-ply
Hand oil can	
Lubricator, 2-in. with valve	

Unit prices on additional drill operating equipment are as follows:

Standard boiler, 25 hp. on wheels, with injector and fittings	$1,140.00
Steam pump, duplex, 6 x 3 x 6-in.	166.75
Suction hose, 16 ft. 2 in., with connections and strainer with union.	17.20
Drill rods, 3,000 ft., 10-ft. sections, $165.00 per 100 ft.	4,950.00
Blank bits, 60, $1.25 ea.	75.00
Core lifters, 12, $1.60 ea.	19.20
Core shells, 8, $4.40 ea.	35.20
Core barrel, single tube, 20-ft., in 2 sections	46.00
Cross chopping bit	19.00
Drive pipe, 100 ft., 4½-in., $1.65 per ft.	165.00
Drive head, steel, for 4½-in. drive pipe	16.00
Drive shoe, steel, for 4½-in. drive pipe	19.00
Chopping bit for 4½-in. drive pipe	19.00
Clamp for 4½-in. drive pipe	20.00
Jar weight, 300 lb.	50.00
Casing pipe, 200 ft., 3 in. (left hand), style flush point, 10-ft. lengths, $135.00 per 100 ft.	270.00
Protectors, wood, for 3-in. casing, 20 pr. at 60c. per pr.	12.00
Casing clamp, for 3-in. casing	14.75
Bushing, rod to 3-in. casing	9.90
Reamer, long, improved, for 3-in. casing	43.25
Reamer face for 3-in. casing	4.70
Pipe cutter for cutting pipe to 2-in. diameter	3.50
Pipe stocks and dies, threading pipe ¼-in. to 1¼-in. diameter	10.75
Chain tongs, 2, No. 34, $10.25 ea.	20.50
Jack screws, 2, $11.60 ea.	23.20
Blocks, 8-in., 1 single, 1 double, with 100 ft. 1-in. manila rope	12.00
Chain, ¾-in., 15 ft., with hook and ring	9.00
Flue cleaner, poker and ash hoe, for boiler	9.65
Shovel (1), crow bars (2), handsaw, files and cold chisels	8.55
Sledge, pick, auger and axe, with handles	8.40
Small pipe, valves and fittings, packing and waste	55.00

BELTING—Present discounts from list in fair quantities (½ doz. rolls):

	Cleveland	Chicago
Leather—List price, 24c. per lin.ft. per inch of width for single ply.		
Medium grade	40– 5%	40– 5%
Heavy grade	30–10%	30–10%
Rubber transmission, 6-in., 6 ply, $1.83 per lin.ft.		
First grade	50–10%	50%
Second grade	60– 5%	50–10%

PACKING—Prices per pound at New York warehouses:

Rubber and duck for low-pressure steam, ⅛ in.	$0.95
Asbestos for high-pressure steam, ⅛ in.	1.75
Duck and rubber for piston packing	.95
Flax, regular	1.15
Flax, waterproofed	1.70
Compressed asbestos sheet	.85
Wire insertion asbestos sheet	1.30
Rubber sheet	.50
Rubber sheet, wire insertion	.80
Rubber sheet, duck insertion	.60
Asbestos packing, twisted or braided and graphited, for valve stems and stuffing boxes	1.40
Asbestos wick, ¼- and 1-lb. balls	.50

PIPE COVERING—Discounts, New York Warehouses, are as follows:

85% magnesia	50%
Asbestos, air cell, 4-ply	70%
Asbestos, air cell, 3-ply	72%
Asbestos, air cell, 2-ply	74%

Petroleum Products

GASOLINE—Prices per gal., 58-60, 437 end point, bulk, as of July 5, 1927:

Refinery		Tank Wagon	
Bayonne, export	$0.09½	New York	$0.19
North Texas	.06½@.06¾	Dallas	.13
Oklahoma	.06½@.06¾	Kansas City, Mo.	.16
Northern Louisiana and Southern Arkansas	.06¾@.07	New Orleans	.17½

NATURAL GASOLINE—Tulsa, Okla., July 1, 1927, per gal.,

A	$0.04½@.04¾	AA	$0.04½@.04¾
B	.04¾@.04¾	BB	.04¾@.04¾
C	.04¾@.04¾		

KEROSENE—Prices per gal., water-white, bulk, as of July 5, 1927:

Refinery		Tank Wagon	
Bayonne, export	$0.07½	New York	$0.15
North Texas, 41-43	.03¾@.04	Dallas	.11
Oklahoma, 41-43	.03¾@.04	Kansas City, Mo.	.106
Northern Louisiana and Southern Arkansas, 41-43	.04½@.04¾	New Orleans	.14

CRUDE OIL—Prices as of July 5, 1927, delivered to the pipelines from the wells 28 to 28.9 deg., per bbl.:

Oklahoma, Kansas and parts of Texas	$1.05@$1.12
West Texas	76
Gulf Coast	1.21
California	.98
Louisiana and Arkansas	1.12
Rocky Mt.	1.12

LUBRICATING OILS—Price per gallon as of July 5, 1927:

At New York	
Black, reduced, 25@30 cold test, in barrels	$0.13½@$0.13¾
Paraffin, pale, 903 gravity, 25.4B, in barrels	.24 @ .25
Pennsylvania, bright filtered, 600E, in barrels	.28 @ .28½
Spindle, No. 200, pale, in barrels	.33 @ .34

At Refineries (200 vis., No. 3 Color)	
Pennsylvania, per gal.	$0.34½@$0.35
Oklahoma (unfiltered), per gal.	.10½@ .11
Texas (unfiltered), per gal.	.10½@ .11
California, 2½ to 3 color (unfiltered), per gal.	.11 @ .11½

FUEL OIL—

New York—July 7, light oil, tank-car lots; 28@34 deg. Baumé, 5½c. per gal.; 36@40 deg., 5½c. per gal. f.o.b. Bayonne, N. J.

St. Louis—July 6, tank-car lots, f.o.b. St. Louis; 24@26 deg., $1.65 per bbl.; 26@28 deg., $1.70 per bbl.; 28@30 deg., $1.75 per bbl.; 30@32 deg., $1.80 per bbl.; 32@36 deg., gas oil, 4.6c. per gal.; 38@40 deg., 5.3c. per gal.

Pittsburgh—July 5, f.o.b. local refinery; 30@34 deg., fuel oil, 4½c. per gal.; 36@40 deg., fuel oil, 5c. per gal.

Chicago—June 25, tank-car lots, f.o.b. Oklahoma, freight to Chicago, 92c. per bbl.; 24@26 deg., 97½c. per bbl.; 26@30 deg., $1.00; 30@32 deg., $1.10.

Dallas—July 2, f.o.b. local refinery, 26@30 deg., $1.40 per bbl.

PARAFFIN—Crude, 122@124 m.p., f.o.b. New York, per lb. 3¼@3½c.

PETROLEUM COKE—Price per net ton, f.o.b. Bayonne, N. J., $10.00.

Miscellaneous

COTTON WASTE—Prices at Warehouse:

	Cleveland	Chicago
White, per lb.	$0.16	$0.15@$0.20
Colored, per lb.	.12	.12@ .17

LIME—Hydrated common, at warehouse, per ton:

Chicago	$18.00	Denver	$24.00
St. Louis	17.50	New Orleans	15.00
Dallas	19.00	Kansas City	15.50
San Francisco	24.00		

PORTLAND CEMENT—Prices to contractors per bbl. in carload lots f.o.b. points listed *without bags*. Cash discount not deducted.

	Current	One Month Ago	One Year Ago
Chicago	2.05	2.05	2.10
Pittsburgh	2.04	2.04	2.09
St. Louis	2.05	2.05	2.20
San Francisco	2.51	2.51	2.31
New Orleans	2.40	2.40	2.30
Denver	2.85	2.85	2.85
Dallas	2.05	2.05	2.05
Kansas City, Mo.	2.10	2.10	2.35

NOTE—Bags 10c. each, 40c. per bbl.; 20c. each in Canada, 80c. per bbl.

Current mill-prices per barrel in carload lots, without bags, to contractors:

Buffington, Ind.	$1.80	Iola, Kan.	$1.85
Universal, Pa.	1.80	La Salle, Ill.	1.90
Mitchell, Ind.	1.90	Hannibal, Mo.	1.90

RED, WHITE AND BLUE LEAD—Per 100-lb. keg, base price, f.o.b. New York:

	Dry		In Oil	
	Current	1 Yr. Ago	Current	1 Yr. Ago
Red	$13.75	$15.25	$15.25	$16.75
White	13.75	15.25	13.75	15.25
Blue (*F.o.b. corroding point*)	.....	.....	13.75	.....

LINSEED OIL—These prices are per 7½-lb. gallon:

	New York		Chicago		Minneapolis	
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
Raw in barrels (5 bbl. lots)	$0.87	$0.89½	$0.86	$0.94	$0.96	$0.99½

OXYGEN—In cylinders, 100 cu.ft. and 220 cu.ft., f.o.b., New York, price per 100 cu.ft., $1.60.

CHLORINE—Liquid, tanks, f.o.b. works, per lb., 4@4½c.

SODA ASH—58%, bags, f.o.b. works, per 100 lb., $1.32½@$1.37½.

FOAM FOR FIRES—Engines, 40 gal. capacity, f.o.b. Utica, N. Y., $300 to $350.

WANTED—Anyone having figures on unit labor cost per square yard of concrete, brick, asphalt, etc., pavement, and per lineal foot of sewer and water systems is invited to send this information to the Construction News Editor, Engineering News-Record, Tenth Ave., at 36th St., New York, N. Y.